WORK

An Illustrated Magazine of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. III.—No. 128.] SATURDAY, AUGUST 29, 1891. [PRICE ONE PENNY.

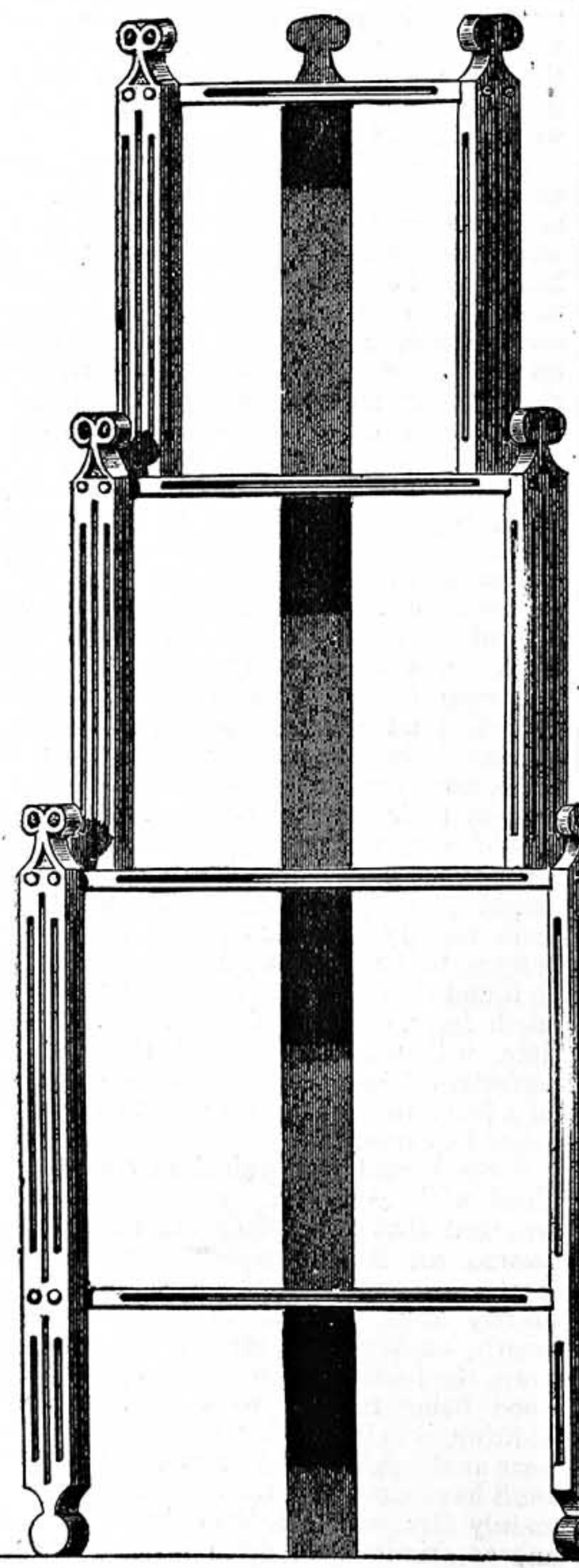


Fig. 1.—Front Elevation of Whatnot on 1½ in. scale.

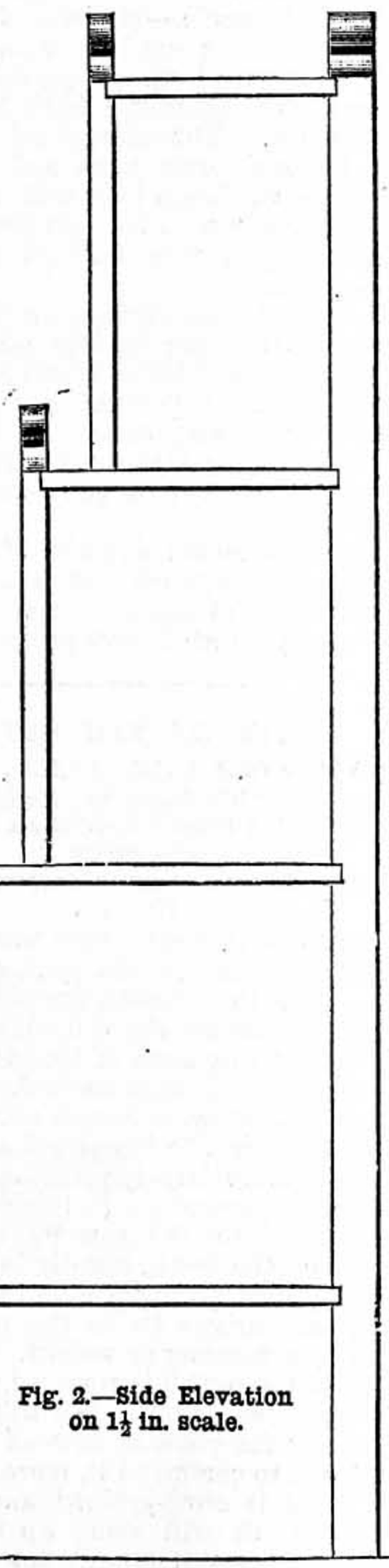


Fig. 2.—Side Elevation on 1½ in. scale.

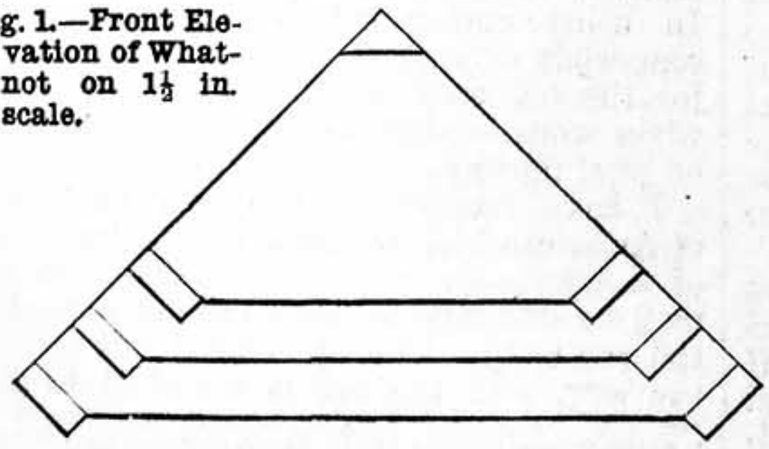


Fig. 3.—Plan on 1½ in. scale.

A WHATNOT FOR AMATEURS.

BY H. J. MARK.

INTRODUCTION—JOINTING—UPRIGHTS—SHELVES—BACK-PIECE—ENAMELLING—FINAL REMARKS.

Introduction.—In submitting to the readers of WORK this simple, yet useful, little article of furniture, I do not do so claiming for it any special merit, as I am but an amateur myself. It is my own design, easy to make, and fills a corner very effectively. To those who, like myself, are not yet so far

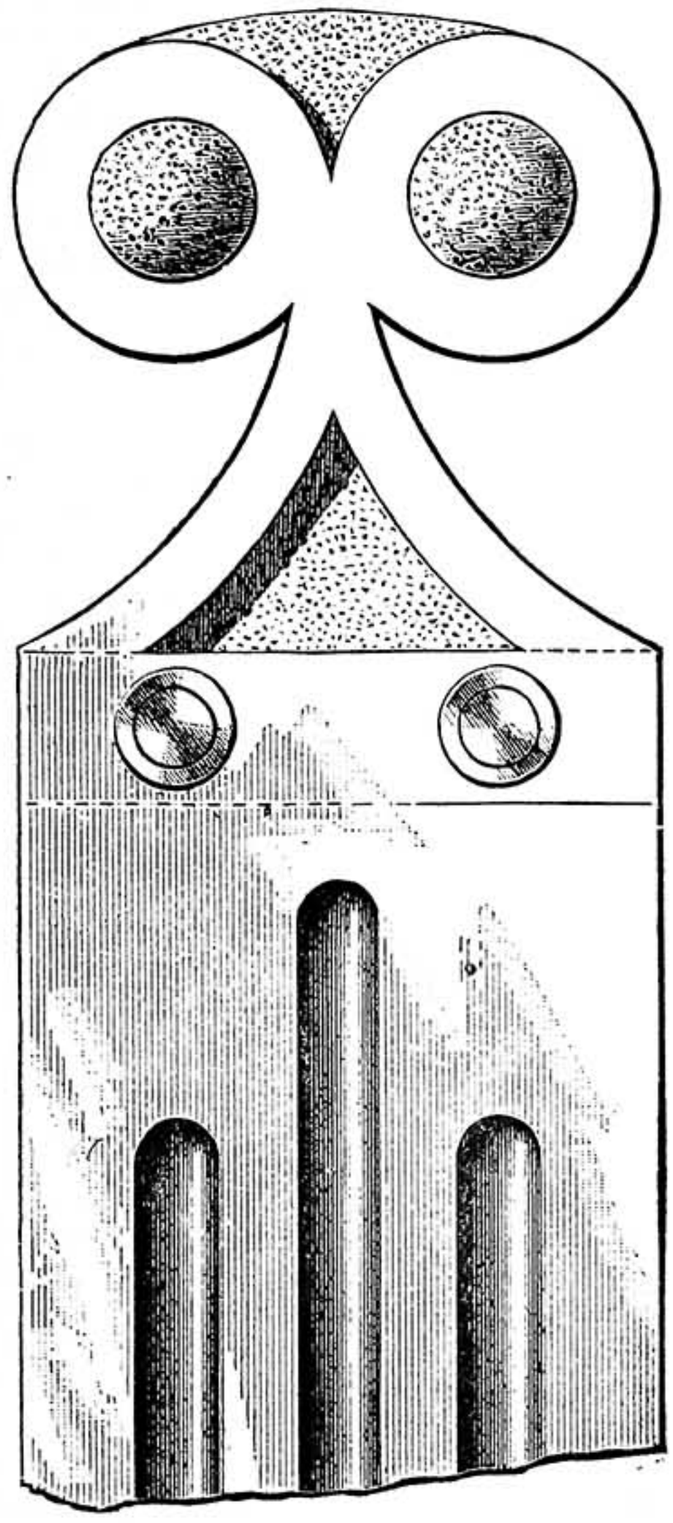


Fig. 4.—Detail of Uprights (full size).

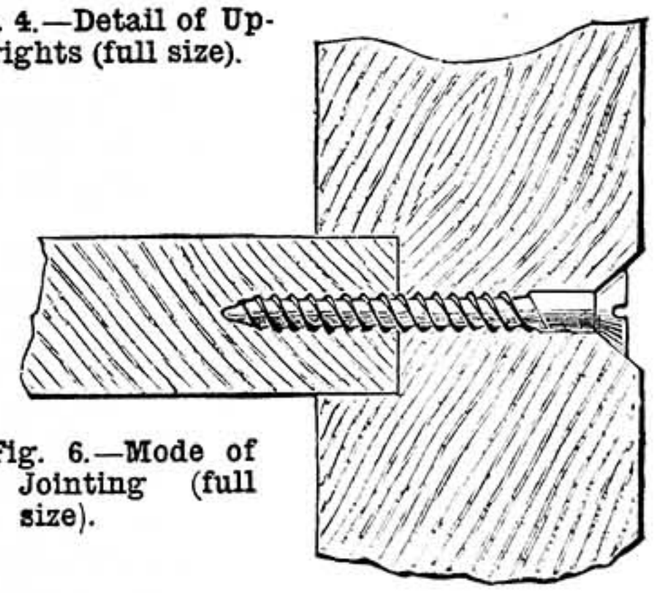


Fig. 6.—Mode of Jointing (full size).

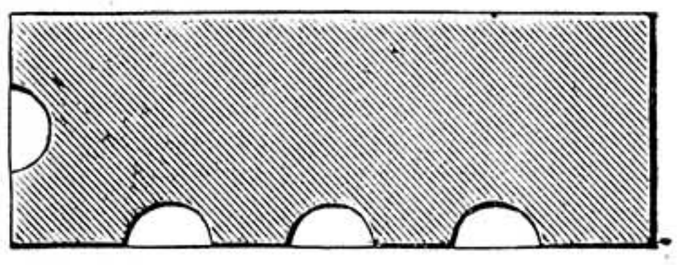
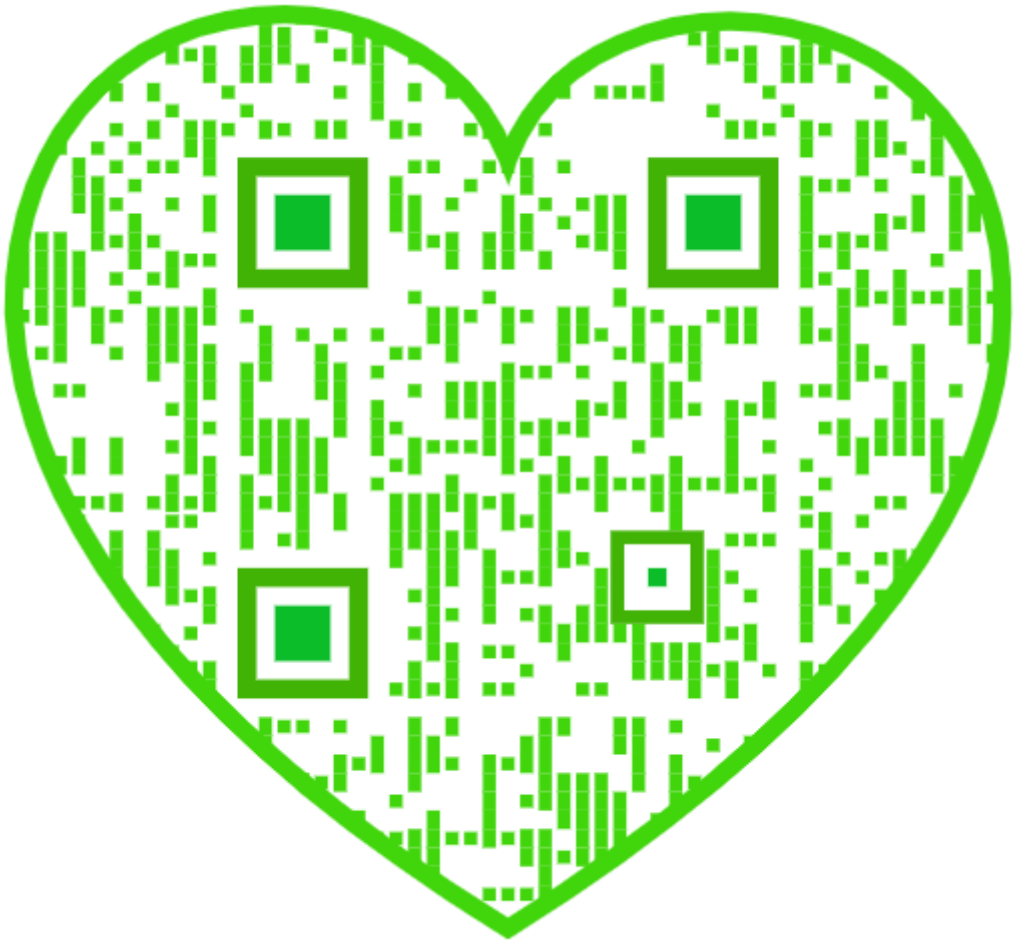


Fig. 5.—Section of Uprights (full size).



advanced as to be able to tackle a hall-stand or bookcase, it may prove useful as a study, if only in the use of the square.

It is made entirely of deal, and finished in two colours of enamel and gold paint. Other woods, of course, might be used, setting aside the enamel and gold, but it would then become more expensive, and expense is a thing we have all more or less to study.

It must be borne in mind that the wood should in all cases be quite dry before working, as if used in a damp state, twists and warps will soon set in, and the work be spoilt. I make it a rule to keep my wood in the house some weeks before using; and by buying it a bit every now and again, I have always a dry piece ready to go on with.

Jointing.—In adopting the manner of jointing shown in Fig. 6, I have done so for the following reasons:—

(1) As I live in apartments, I must make my furniture so as I can take it to pieces readily for packing purposes. (2) As each piece is enamelled more easily and better by being done separately than if done when fitted up and put together.

As a consequence, I have not used any glue, and as stability is the main thing to be desired, I consider my method to be the best; glue is a messy substance at all times, and unreliable as a joint unless applied by practical workmen. And I consider that if more screws were used in putting together our modern furniture, and less glue, we should have far stronger articles for our money.

For all the joints out of sight I have used $1\frac{1}{4}$ in. screws; for the joints in front I have used fancy brass-headed $1\frac{1}{4}$ in. nails, as shown in Figs. 1 and 4. In driving in the nails the head of the hammer should be covered with a piece of soft leather for the protection of the brass heads. The bare hammer will flatten and scratch them, and spoil their appearance.

Uprights.—The uprights are $\frac{3}{4}$ in. thick, and, of course, cut out of one piece of stuff, taking care to allow for the recessing into the shelves. All the recesses need not be more than $\frac{3}{16}$ in. deep. The heads and two feet I shaped out with a fret saw, the speckled portions shown in Fig. 4 being a little diaper work punched over. The grooves are all cut with a $\frac{1}{4}$ in. gouge: at least, that is the way I have cut mine, but those who have a suitable plane or "scratch" could, of course, use it to advantage. After cutting the grooves, to get them smooth I rounded off a piece of wood to fit them loosely, and by its aid and sand-paper rubbed them down. Fig. 5 is a full-size section from which the gauge may be set for marking them out.

Shelves.—Fig. 3 is a plan giving sizes of shelves ($1\frac{1}{2}$ in. scale), the two bottom ones being of the same size. These can also be set out on and cut from one piece of stuff, and are $\frac{1}{2}$ in. thick, taking care as before to allow for recessing into back-piece, the grooves on their front edges being worked the same as for the uprights. They are recessed into uprights as well, care being taken to get the uprights perfectly square within the shelves, or when put together they will stand lop-sided.

Back-piece.—The back-piece is a triangular piece of wood, as shown in plan, 4 ft. long, and with a 2 in. face, the two sides forming a right angle, so as to fit the corner of a room. The head-piece I have not diapered, as it would be hidden by a vase, etc. For the same reason I have not shaped the foot.

Enamelling.—After having fitted the whole together, taken to pieces, and thoroughly sand-papered the parts, give a coat of size and whiting mixed as a filling; when dry, sand-paper again, and proceed to enamel. I use about three dessert-spoonfuls of whiting to half a pint of weak size. All the grooves, with the exception of the middle ones of the uprights, are coloured in turquoise blue. The middle ones, together with the diaper work, are worked in gold paint; the rest of the whatnot is done in Arabian brown. Two coats of each is sufficient. I have used Blundell, Spence & Co.'s enamel and gold paint, and find it very good; I prefer it to others, as it dries with a higher gloss.

Final Remarks.—If nicely finished, with one or two vases and like ornaments placed upon it, it will, I am sure, give satisfaction. On my own whatnot I have hand-painted flowers, etc. The enamel colours may be left to one's own taste and inclination; those I have chosen look well, the blue contrasting nicely with the rich brown, and the gold giving a very finished and artistic appearance.

A further improvement might be made by converting the middle portion into a cupboard with folding doors, having either carved, fret, or painted panels. For instance, the two panels of the iris and narcissus by Mr. Gleeson-White (see WORK, No. 60, page 125); or gesso-work might be utilised.

One word more: don't be afraid of using the square too much. It is a maxim that an old friend of mine, a carpenter, gave me, and one by which I have profited.

NOTES ON SAW SETTING.

BY M. POWIS BALE, M.I.M.E., A.M.I.C.E.,
Author of "Wood-working Machinery," "Saw-Mills," "A Handbook for Steam Users," &c.

SWAGE SETTING—SPRING SETTING—HAMMER SETTING.

IN very few things is there more difference of opinion than in sharpening and setting saws. On the present occasion I propose to discuss briefly the different methods of setting, noticing some of the advantages and disadvantages of each method.

Swage Setting.—Swage setting—called also "upsetting," "jumping," and "spreading"—is more largely practised in America than in this country. In this case clearance is obtained for the saw by widening the points of the teeth, usually by means of a crotch punch arranged with two V notches, which are driven on to the points of the teeth by a hammer or weight. The second notch in the punch is rounded, and spreads the teeth points out. We think this plan, especially for circular saws of stout gauge, has much to commend it, more especially if the wood is cross-grained and knotty, as swaged teeth will stand up to the work, while spring-set teeth are apt to dodge the knots. Swaged-set teeth will also stand a quicker feed than spring-set, all things being equal; they, however, take more power to drive—probably about 20 per cent.—and unless the setting is carefully done ridge marks are left on the log. I think swage setting is, on the whole, more adapted for soft than hard wood.

It is claimed by the users of swaged-set teeth that swaging condenses and hardens the steel at the points of the teeth; but if this is so, with saws correctly tempered it would, I take it, be likely to be detrimental, and cause the points to crumble. Another trouble found in swage setting is the difficulty of getting perfect uniformity of set, without which no saw can be pronounced to be in first-rate cutting condition. Swage setting does not sharpen the teeth of the saw, as some may suppose.

When a saw is set or spread by means of a punch and a blow from a hammer, care should be taken that the points of the teeth only are spread, and that the tooth itself is not bent or strained, and that the blow given and the hammer used are not too heavy. The teeth should be carefully tried with a straight-edge on both sides and points, and be exactly in line. In swage setting, should a tooth point be broken by striking a nail, it can be lengthened slightly by raising the punch or swage when in the act of setting the tooth, and the point of the tooth will be upraised, and, if not too much broken, will take its share of duty with the rest.*

To "spread" set all the teeth as nearly as possible alike with a crotch punch, it is necessary to regulate to a nicety the weight or strength of the blow given by the hammer. In America a tool has been introduced to do this mechanically. It consists, briefly, in mounting the crotch punch on the end of a tube or rod, and arranging a series of movable weights, with holes through them, to slide up and down the rod. These weights are allowed to drop on the punch, the strength of the blow being regulated according to the gauge of the saw and the amount of set required. For saws of large diameter and thick gauge spread set can be recommended, as it is very difficult to spring set or bend the teeth of a thick saw with regularity.

Spring Setting.—This is perhaps the most general kind of setting, and, if regularly and carefully done, answers very well; the teeth, however, have a constant tendency to assume their original position. Saw teeth should not, under any circumstances, be set without a gauge, as it is a wasteful and stupid plan, producing rough work, and more rapidly wearing out the teeth which happen to be overset. In practice it will be found that a saw perfectly set will work much freer, cut smoother, and, at the same time, will waste less wood than an imperfectly set one; less set is also required on a truly and equally set saw to effect the desired clearance.

Several good mechanical saw sets, combined with gauges, are now made, and so arranged that when they are fixed to any desired set it is impossible to overset a tooth; consequently, the teeth are all set exactly alike, and, if they are equal in length, each tooth gets its fair share of work, the friction of working and waste of wood being reduced to a minimum. In working, it is found that the teeth of a saw wear at the side of the points, and if some teeth have more set than others, these are unduly strained, and, from the severe and uneven friction, are often heated, and are inclined to buckle and run from the line. In using spring set, it is necessary to somewhat overset the saw, to compensate for the tendency of the teeth, especially when worn or dull, to spring back to their original position.

I have recently seen a very neat form of American tool for spring setting by means of a cam-lever, by which a very even set may be obtained without unduly straining the saw teeth. The operator stands behind the saw, and the set is attached to the

* See "Saw Mills; their Arrangement and Management," by M. Powis Bale.

teeth by placing a bed die on the point of the tooth to be set, so that the point will project beyond the die about one-sixteenth of an inch; the cam-lever is then brought down to a stop on the cam, at the same time bending the teeth towards the latter. A four-point gauge is fitted to the lever, and it can be adjusted to any amount of set desired by means of a thumbscrew. It is claimed as an advantage of this arrangement that the bending power is exercised on the tooth between two bed bearings, so that the operator has only to bear down on the cam-lever, and the more power he applies the tighter he fastens the set to the saw; and, at the same time, the bend is a curve and not an angle, and that, therefore, the saw teeth are less liable to fracture.

If a saw is allowed to get dull it will spring from the work, and increased power will be required to force it through the wood.

Hammer Setting.—The third system of setting I have to notice is hammer setting. The old-fashioned way of doing this was with a punch and a block of wood, and a very brutal way it was, as it strained the saw-plate, and sometimes broke the teeth; at the same time, it was impossible to get the teeth to one uniform set, consequently the timber was scored, and much power consumed unnecessarily. If carefully and judiciously done, hammer-set saws will stand up well to their work. The best plan with which I am acquainted is to mount the saw horizontally on a conical centre, and allow the teeth to rest on an adjustable steel die made with a bevel edge turned eccentric, so as to allow of the right proportion of set for teeth of various sizes. With this arrangement any desired amount of uniform set can be given to the teeth without unduly straining them or the saw-plate. Hammer setting is a fair test as to the quality of the saw, as the teeth may crack or fracture if the steel is burnt or of too hard a temper, or bend readily if too soft.

In conclusion, it must be borne in mind that whatever kind of setting is employed, for successful and economical working *absolute uniformity* is imperatively necessary. If this is not secured, the work turned out is of inferior quality, and wood and power are wasted. It should also be remembered that setting does not increase the cutting power of a saw, as a saw will cut faster with little or no set, provided the nature of the wood will allow it to pass through without binding. The amount of set required, therefore, should be carefully judged by the sawyer, and no more set employed than is absolutely necessary. For instance, in sawing wet wood a sharp saw and a fair amount of set are required, whilst for hard knotty wood very little set should be used.

PRACTICAL PAPERS FOR SMITHS.

BY J. H.

Punching and Drifting.

As the moulder cores holes in his work in order to avoid altogether, or to lessen, subsequent labour, so the smith punches and drifts rough holes in his work for the same purpose. Punching, drifting, and drilling are the three methods by which holes are commonly made in the smithy. The first two are performed on red-hot iron and steel; the last, and sometimes the second also, on cold metal. The present article will deal only with punching and drifting.

Iron and mild steel will stand punching to an extent that would be impossible in a crystalline material like cast iron. For much work punching makes a clean, finished hole, to which nothing is done subsequently, and is quite good enough for its purpose. In other cases, punching, like the coring of castings, takes out the bulk of the metal, leaving a certain small allowance for finishing with drill, rymer, or boring tool. Generally the details of the process of punching are as follows:—

The iron to be punched, being brought to a suitable full red or white heat, is laid across the anvil, and the punch (Fig. 12) is driven about half-way through by means of the sledge or hand hammer, from one or two to several blows being required, depending on the thickness of the material. The punch is then withdrawn, and the iron is turned over and laid upon its opposite face. A dark spot indicates where the chilling effect of the punch has taken place, and enables the smith to set the punch again in position for piercing the supplementary portion of the hole. The tool is then driven through—the holes meeting. During the formation of the second portion, the work is either laid upon a bolster of the form shown in Fig. 13, or over the hole in the anvil, and the punch then passes freely through.

If the hole is deep, the hot iron closes and tightens around the punch, and the latter is therefore withdrawn at every three or four blows. Further, the heat of the iron is communicated to the punch, and makes the latter very hot, so that after every three or four, or half dozen, blows, it is necessary to dip the punch in water to cool it.

These punches are made circular, square, oval, oblong, and wedge-shape in cross section. They are handled with hazel or iron rods, or with rigid wooden handles passing through eyes.

The methods of producing punched holes are varied according to circumstances. If it is desired to preserve the same, or nearly the same, amount of metal all around the hole, the hole is not punched absolutely, but partly punched and partly drifted or opened out. Obviously, when a hole is punched entirely with a blunt-pointed tool, like Fig. 12, the amount of metal removed is equal in area to the area of the point of the punch itself, and the width of the bar will not be perceptibly increased (Fig. 14).

But there is another way of making a hole without weakening the bar to any great extent. A conical punch—that is, one tapered down nearly to a point—may be inserted, and the hole be formed and opened without the removal of any appreciable quantity of material. Or if a hot set is driven into the bar half-way through from one side and half-way across the other (Fig. 15), then a punch or drift can be driven in afterwards, and the slit opened out into circular or oblong form, as may be required, and the metal on each side thrust outwards, the full area being retained, save and except only that due to the stretching of the metal. This is often done.

Thus, for example, take long slot-holes. These are cut in two ways. In one, holes are punched at each end of the intended slot equal to its width, and the metal between is cut out with the hot set, cutting from opposite sides in succession, the cuts meeting in the middle (Fig. 16). In the other case, holes are punched at each end, and a chisel cut put down the centre from hole to hole, and a drift inserted and the metal opened out (Fig. 17). In this way the flanking metal is thrust out sideways, and the bulk of its section retained. Such a slot-hole is finished by the insertion in the hole of a drift or mandrel of the correct section, and the hammering of the outside edges of the bar upon it.

When punching holes, it is necessary to take account of the direction of the fibre—a matter treated of in the last volume of WORK. Unless attention is given to this, the iron will become divided instead of spread out. In any case, punching puts considerable tension on the fibres around the hole, with reduction of area, and it is an operation, therefore, that requires to be done with judgment.

To punch slotted cottar ways in which the section of the iron is not enlarged, take a tapered oblong punch or drift of steel, like that shown at Fig. 18, A, with rounding ends. Raise to a welding heat, and properly support the iron, according to its shape, upon a bolster or upon a bottom tool, and drive the punch half-way into it. Turn the iron over, cool the punch in water, and drive it in exactly opposite to the first position until the openings meet at the centre of the bar. Since the punch is tapered slightly, the hole is doubly tapered. It is also rough. A parallel drift or filling-piece is then taken and driven into the hole. The outside of the iron is then smoothed and finished, and the hole accommodates itself to the form of the filling-piece. When the shape is completed the filling-piece is driven out. This method of finishing hollow work while a central punch, drift, filling-in piece, or mandrel remains in *situ* is one adopted in many classes of work.

Fig. 18 illustrates the punching a hole through a stout pin. The pin selected for this example is $3\frac{1}{4}$ in. diameter, and the hole measures $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., and it is made at one heat. The punch is shown at A. Its body below the handle is about 6 in. long, and well tapered. The bar being brought to a white heat, the punch is driven from one side almost, but not quite, through. It is driven so far that the position of the hole when it nears the opposite side to that from which the punch is driven is indicated by a darker colour of the iron. Then the pin is turned over and the punch driven into that darker spot, and the hole completed. Of course, during the punching of the hole from one side nearly through to the other the tool has to be removed several times, from four to half a dozen, and cooled in water. Further, it is not so easy to make a deep hole in a stout circular bar as it is in a thin flat bar, and the smith has to look out to prevent the hole from running to one side, and to indicate to the strikers in which direction they are to apply their blows. Moreover, two strikers are necessary to get a hole through this depth at one heat.

At the first stage of making the hole, the pin lies upon an ordinary bottom swage. At the second stage it lies upon a bolster, B, in form like a hollow swage, but pierced with a central hole, through which the drift can find a clear way.

When the hole is thus roughly punched, the metal around it will be partly compressed, partly bulged; very little, not one-sixth, perhaps, is actually driven out and removed by the punch. The bulging of the bar is corrected by hammering between top and bottom swages, and then the hole is

finished by drifting, all being done during the one heat. The drift is shown in Fig. 19. It is slightly tapered. A few blows of the hammer are sufficient to send it through the hole, opening it out. It is driven from each side in turn, and in this way the hole is made practically parallel.

During the punching of the hole, whenever the punch is withdrawn to be cooled, the hammerman strews a little small coal in the punched hole. This burns up gas which would otherwise offer much resistance to the passage of the punch.

Holes that are punched smaller than the finished dimensions are, when not intended to be machined, almost invariably finished with drifts. These are tapered or parallel tools, whose cross sections are those of the finished holes — circular, square, oblong, elliptical, or polygonal in form. The drifts are smooth, and being driven through the punched holes while red-hot, both enlarge and smooth them. Two drifts are often employed: a first one with considerable taper lengthwise, for the purpose mainly of enlarging the punched hole; a second with the merest trace of taper, for imparting the precise finished dimensions. The latter is then called a filler, or filling-in piece, or mandrel.

There are several forms of drifts. When we speak of drifts, the boiler-maker's drift is not included. The function of that tool is the pulling of the punched holes in plates into line. The tool is very slightly conical in form, and being driven through overlapping holes in contiguous plates, it thus brings those holes into line by the stretching of the plates, and so permits the rivets to pass through. The blacksmith's opening or non-cutting drift is used not for the same purpose, but in like fashion, its object being the enlarging of holes in hot metal.

Drifting may thus mean either one of two operations. It may mean the simple opening out by internal pressure of a hole already punched by means of a smooth punch-like tool; or it may mean the cutting and shaping of a punched hole to a finished and accurate form by means of a serrated tool.

In each case, drifts, like the punches, may be of any cross section—circular, oval, square, oblong, rhomboidal, parallel, or tapered, to suit the work in hand, and there is scarcely a limit to the forms in which they can be made and used. In each case the main idea is to save more expensive machine work.

In consequence of the modern improvements in metal-working machines, the value of drifts as shaping tools has much diminished. Thirty or forty years ago they were very much used, and are even now in many country shops and smithies. There are many small shops in which there is no slotting machine, and in these the drift is still one of the most serviceable substitutes.

Smooth drifts are rarely or never perfectly parallel, because the shrinkage of the forging around a parallel drift would render its withdrawal from the hole a matter of difficulty. In any case, the sides should subtend angles of not less than from two to four degrees. Not that a smith measures such an angle; he simply judges by the eye, or perhaps tests with callipers, the slight amount of taper given.

The cutting drift partakes either of the nature of a sharp punch or of a file. It does not open out by tension, but removes material from a roughly-punched hole. It will not remove a large quantity of material at once, but merely smooths and finishes a hole already nearly to shape and size. Fig. 20 shows a drift of the first kind, and Fig. 21 one of the second. The first is suited to shallow holes, the second to those of considerable depth; they are shaped with files from suitable blanks, and then tempered to a plum colour, or the colour between a brown and a purple. Obviously, the cross sections of these drifts may differ to any extent to suit any class of work. For fine work the teeth of the serrated drifts are set closer together; for coarse rough work they are spaced farther apart. They are bevelled to allow clearance for the chips, being the equivalent of backing-off in other cutting tools. For hard metal the angle between the cutting edge and the face is greater than for softer metals, thus following the practice in all cutting tools.

Oil should be supplied to the edges of the drift and of the hole when driving it in, and the work should be bedded firmly on a block of metal. Care must be taken that the drift is driven straight, as it is apt to run to one side—a tendency to be corrected by driving it in the opposite direction. If the hole is deep, the drift must be withdrawn once or twice for clearance of chips, or to remove excess of metal by chipping.

If the hole to be drifted is much smaller than the finished size, it will be necessary to enlarge it by chipping in such parts as may require enlargement.

The serrated drifts are used for making round holes square, round holes oval, round holes hexagonal, and so on. It is better in these cases to work one-half the hole at a time than to endeavour to cut on all sides at once. Thus, in cutting a square hole from a round one, one-half the drilled hole would be filled up with a half-round bit, and a flat drift operated against the other half of the hole little by little, thin backings being interposed one after the other. When one-half was shaped it would be filled up and the other half treated similarly. An oval hole would be shaped in the same way.

The drift is serviceable not only for thoroughfare holes, but for holes that do not pass right through their material. It is difficult to shape such holes by any other means than with a drift. And with a drift any number of holes can be smoothed and finished all alike. Taking, for example, a rectangular hole to be smoothed in one direction, the drift in Fig. 22 could be used. The face, A, would remove a thin shaving. To take a second cut, a thin strip of metal would be placed behind the drift; to take a third cut, another thin strip; and so on.

Cutting drifts are also used for finishing edges of work, such as the teeth of wheels, ratchets, etc. In this case the resistance is obtained by means of a strap-like fitting attached outside the work, against whose face the back of the drift slides.

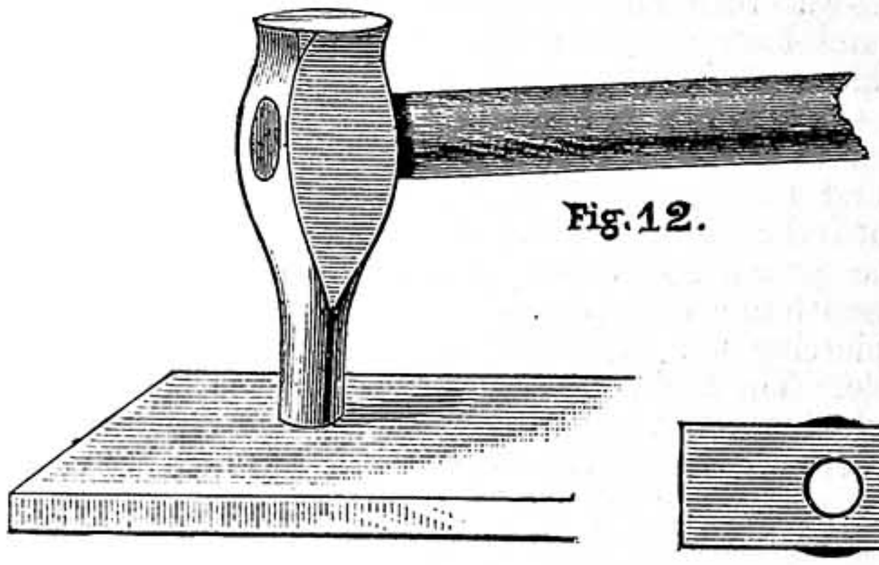


Fig. 12.

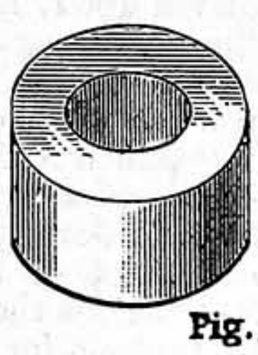
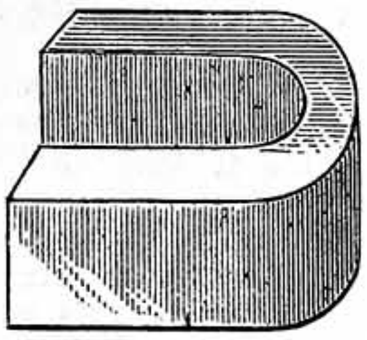


Fig. 13.



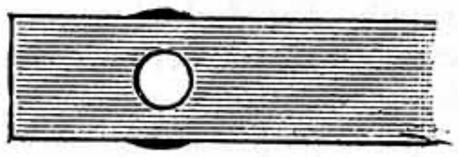


Fig. 14.

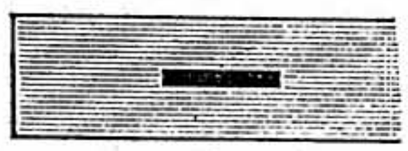


Fig. 15.

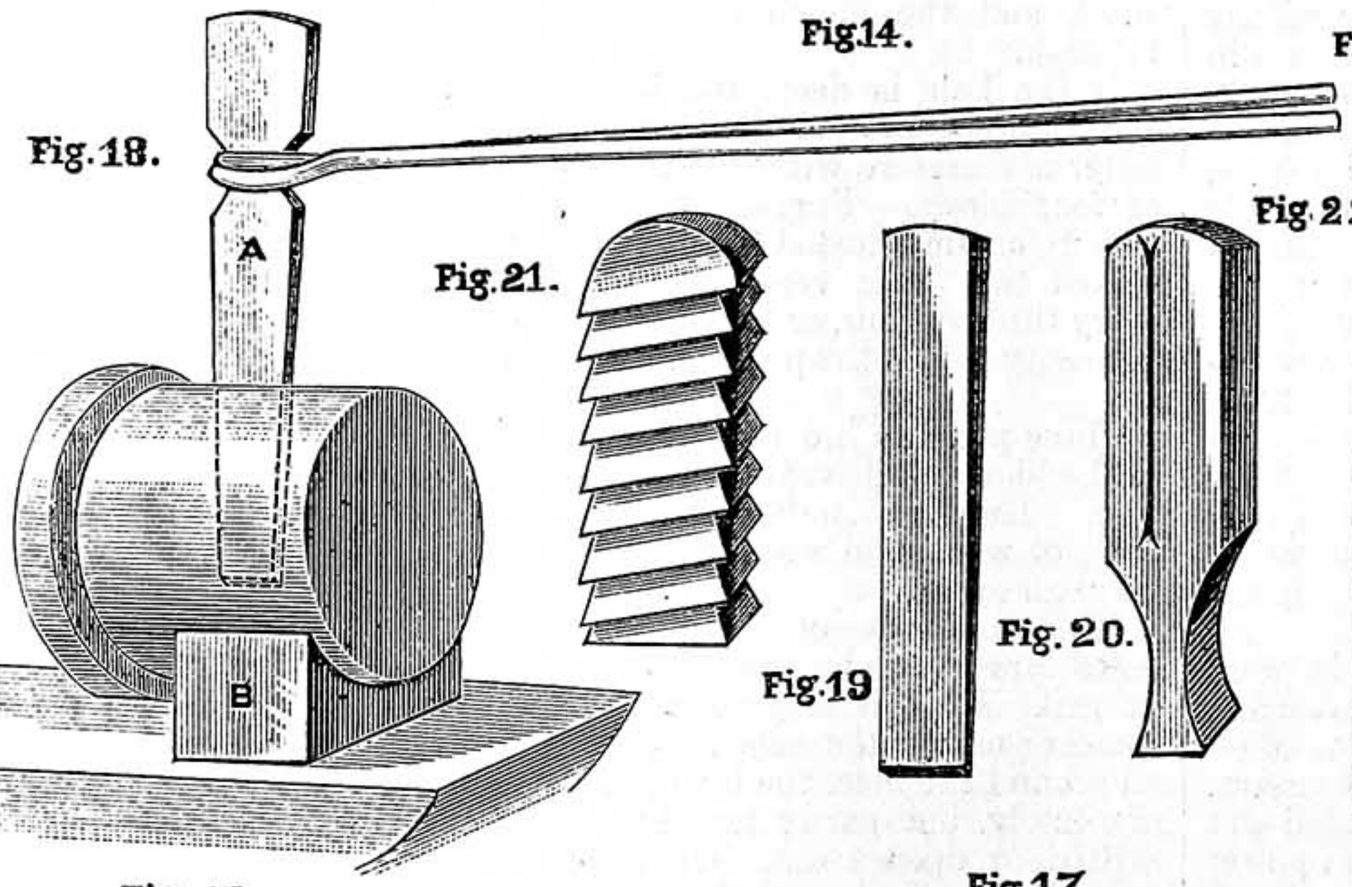


Fig. 18.

Fig. 21.

Fig. 19.

Fig. 20.

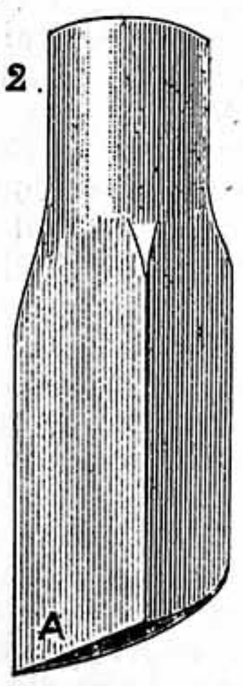


Fig. 22.

Fig. 16.

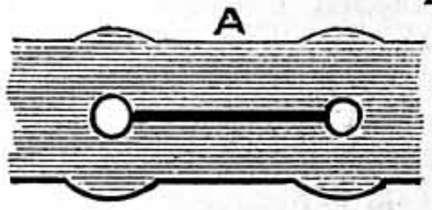


Fig. 17.

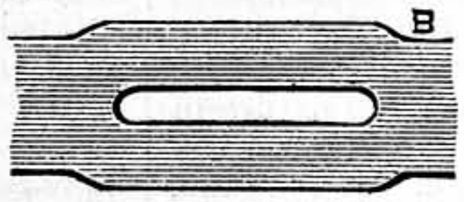


Fig. 12.—Round Punch operating on Thin Bar. Fig. 13.—Bolsters. Fig. 14.—Shows Removal of Material by a Blunt-pointed Punch. Fig. 15.—Shows Advantage of commencing Hole with Hot Set. Fig. 16.—Cutting of Slot-Holes in which Area of Bar is reduced. Fig. 17.—Cutting of Slot-Holes in which Area of Bar is retained: A, Commencement; B, Finish. Fig. 18.—Illustrates Punching of Hole through Stout Pin. Figs. 19, 20, 21, 22.—Drifts.

A WHEATSTONE METRE BRIDGE.

BY H. A. MILES.

USUAL FORM OF BRIDGE—PRINCIPLE—EXPLANATION—MATERIALS—DIMENSIONS OF PARTS—THE SCALE—METHOD OF DIVIDING—THE WIRE, BEST METAL—GAUGE—COMPLETION OF BRIDGE—EXAMPLE OF USE—DESCRIPTION OF MORE ACCURATE FORM OF BRIDGE.

Usual Form of Wheatstone Bridge.—The "Wheatstone Bridge" or "Balance," if made in the form of a number of coils of fine wire of varying resistances, is a job rather outside the ability of the average amateur to construct; moreover, a certain amount of apparatus is indispensable, as a Wheatstone Bridge and Bridge Galvanometer are absolutely necessary, in order that the resistances of the coils may be accurately determined. The principle on which the bridge is based is shown in Fig. 1. The arrows denote the direction of the current flowing through the conductor, which is so divided as to offer two paths between certain points. If the resistance of the two paths is alike, an equal proportion of current will flow through each; and if a galvanometer be introduced between the arms (as shown by the dotted lines), no deflection would be observed. If, however, one arm offered a greater resistance than the other, there would at once be a fall of potential, and a current would flow between the two arms through the galvanometer; and the deflection obtained would depend upon the amount of difference between the two.

Principle.—If the arrangement just described is still retained, adjustable resistances inserted in three of the arms, and the wire to be tested used as the fourth arm, it will be a simple matter to ascertain its resistance by varying that in the other arms until the needle stands at zero. (*See* Fig. 2.)

Explanation.—The design it is proposed to construct, generally called the "Metre Bridge," is shown by Fig. 3, and the parts are lettered, so as to correspond with the preceding illustration: A is a known resistance, D is the line to be tested, B C is a fine German-silver or platinum wire stretched between the two brass ends. The galvanometer is connected to the middle brass strip and to the German-silver wire, the exact point at which the contact is made being found by trial, and being the point at which no current passes through the galvanometer; then the two sides of the German-silver wire bear the same relation to each other as the known to the unknown resistance.

Materials.—The material used for the base may be of pine or any other wood, mahogany being preferable. The length will depend on the size of the scale. If this is a metre in length, the base should be fully 44 in. There is, however, no necessity for the scale to be exactly a metre long, as any length can be equally divided into the requisite number of parts, but the longer the wire is the less liability is there for errors to arise. As a more complicated design is described later on for those who desire a better article, it is thought that the present one may be made with a 24 in. scale. Should anyone, however, wish to make it full size, no difficulty will be found in altering the dimensions to suit.

Dimensions of Parts.—Let us, then, start with the data necessary for a bridge with a 24 in. scale. The base will be 28 in. long, 4 in. wide, and $\frac{3}{4}$ in. thick. This should be planed up square, and a neat moulding worked all round the edge. A small turned knob may be fastened on under each corner as feet, and the whole French-polished or sized and varnished.

Some rolled copper or brass strip should now be obtained, a good size being $\frac{5}{8}$ in. by $\frac{3}{16}$ in. Two pieces 3 in. long (one for each end) and another piece 22 in. long will be required. These should be squared up at each end and holes drilled, both for screwing to the base and to receive the terminals. They should next be polished up, and lacquered with pale gold lacquer. The two short pieces should now be screwed down to the base, exactly 24 in. apart, and the long piece screwed on near the back edge.

Dividing the Scale.—To construct the scale, take a strip of cardboard, 25 in. long, leaving $\frac{1}{2}$ in. at each end of the scale to be gripped under the brass strips. The 24 in. should be accurately divided into a certain number of equal parts—five hundred will do very well—and numbered from each end, as shown in Fig. 4, which represents a portion of the scale. The divisions may be obtained by the method illustrated in Fig. 5, two lines being set out at similar angles from opposite ends of the given line, one above and the other below. If these are now divided into the required number of parts to any convenient size, and parallels drawn as shown, the intersections of the horizontal line will be the required divisions.

When finished, the scale should be sized and varnished, colourless materials being used, after which it may be glued down to the base between the two brass ends, which should be temporarily removed. A better job may be made of it by cutting a shallow groove in the base, and thus sinking the scale in flush with the polished surface of the base. If this is not done, it will be necessary to scrape off most of the polish from below, to aid the glue in securing a good hold. A couple of small brass nails should now be hammered in the base, one at each end, under where the brass strips are fastened, and in such a position that a piece of wire stretched from one to the other would lie exactly in the centre of the scale. (*See* Fig. 4.)

Wire—Best Metal—Gauge.—The wire, which is preferably of platinum or platinoid,

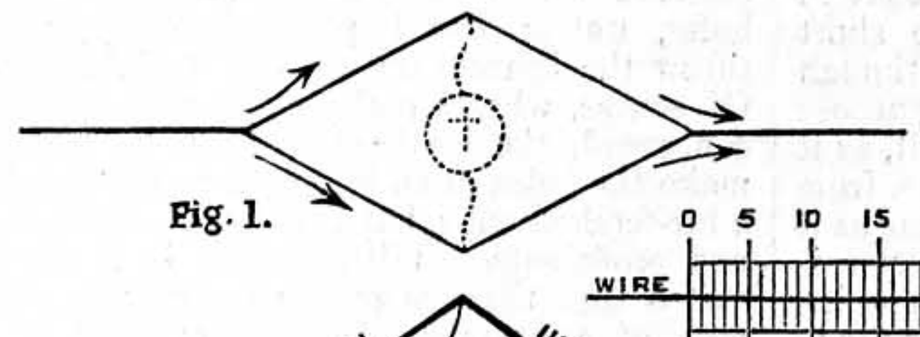


Fig. 1.

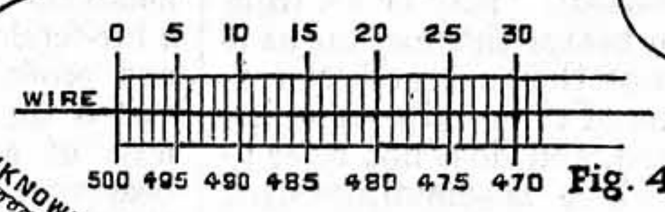


Fig. 4.

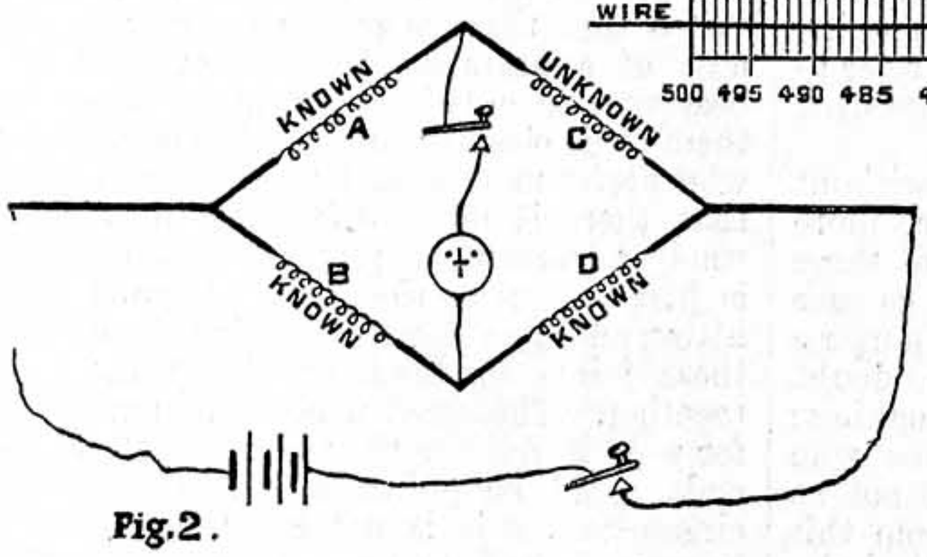


Fig. 2.

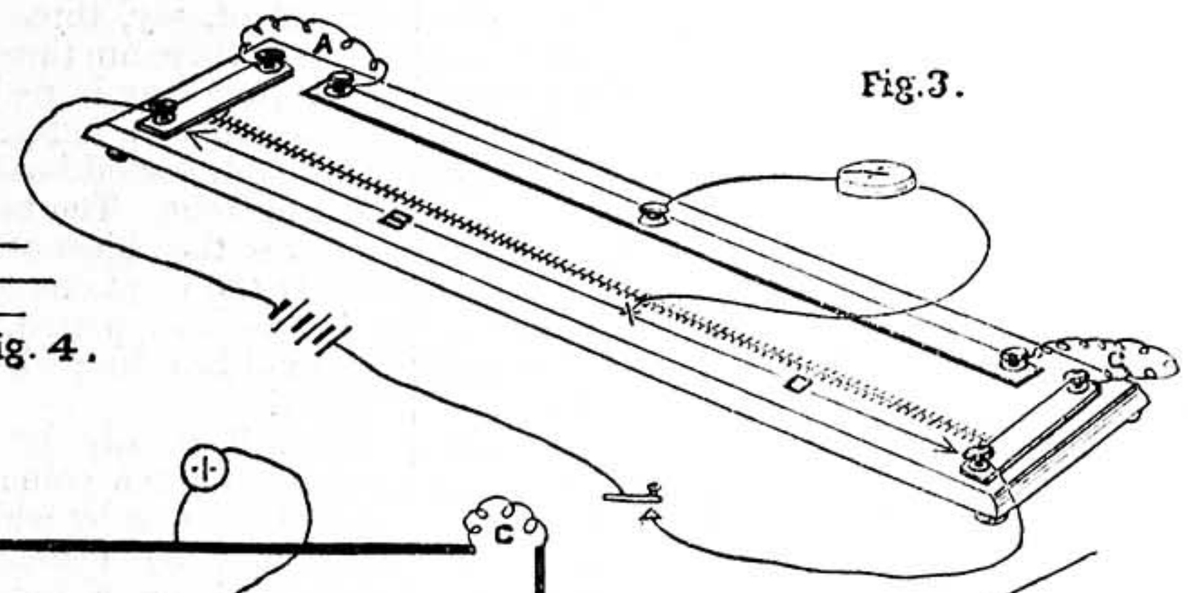


Fig. 3.

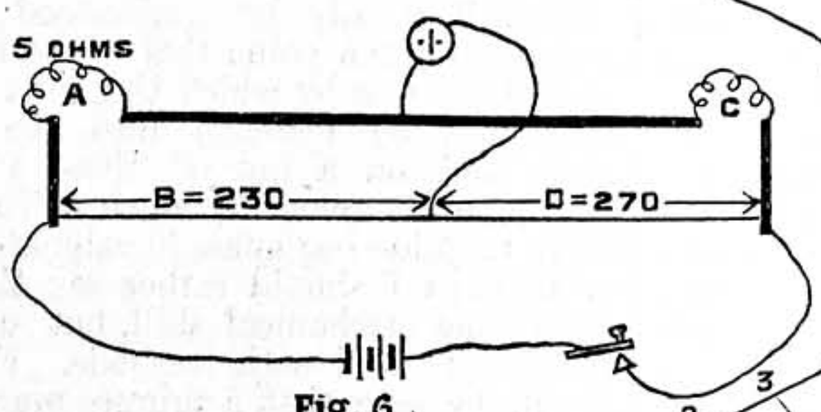


Fig. 6.

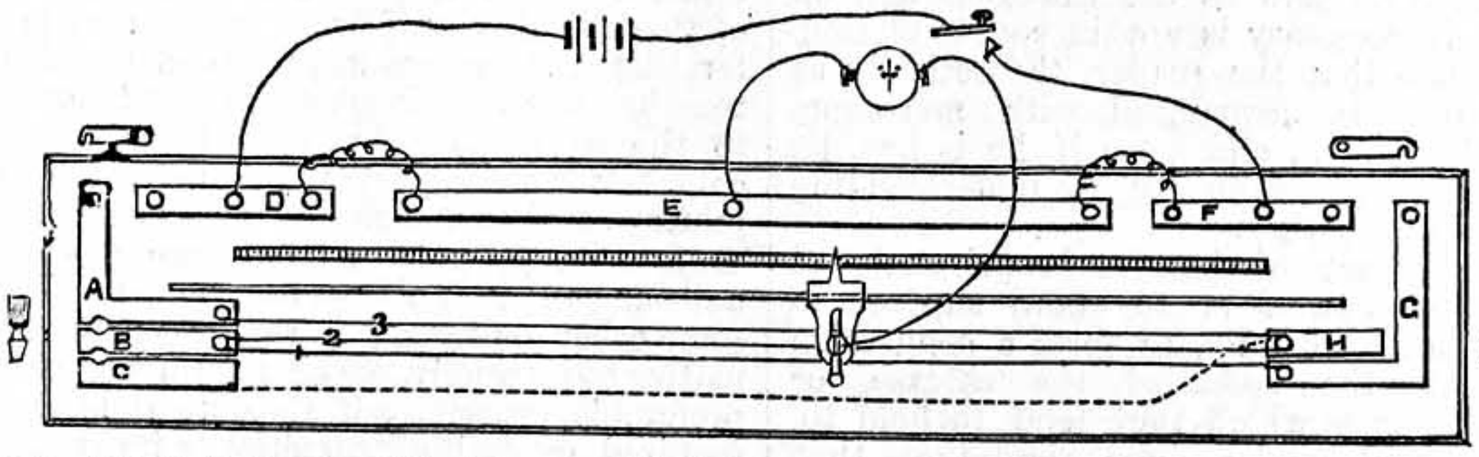


Fig. 7.

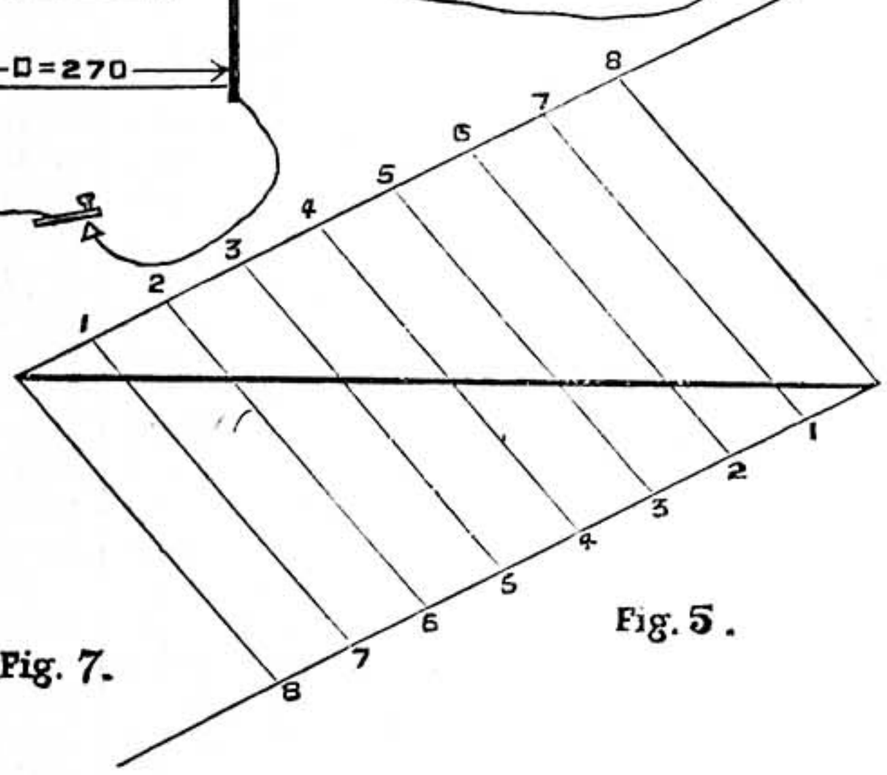


Fig. 5.

Fig. 1.—Diagram showing Principle on which Bridge is based. Fig. 2.—Method of testing Resistance. Fig. 3.—The Wheatstone Metre Bridge. Fig. 4.—Mode of graduating Scale. Fig. 5.—Mode of obtaining Accurate Divisions. Fig. 6.—Diagram illustrative of Example given of Use of Bridge. Fig. 7.—A better and more elaborate Form of Wheatstone Metre Bridge.

though German silver does very well, is of No. 30 gauge, and should now be strained across from one nail to the other, bound round two or three times, and the nails then hammered in nearly flush. The brass ends may now be replaced and screwed tightly down, so as to ensure good contact with the wire. The terminals may be screwed into position, and the bridge will be complete.

Example of Use.—An example of its use is given here. A coil of wire, known to offer a resistance of, say, 5 ohms, is inserted at A, and the unknown length at C; then

$C = \frac{D}{B} \times A = \frac{270}{230} \times 5 = 5{\cdot}85^{\omega}$, as shown in Fig. 6.

The bridge just described is of the simplest form. I shall now briefly show how a better one may be made on the same general principles. This is shown in Fig. 7.

Description of a more Accurate Form of Bridge.—In this case the scale had best be a metre in length, and divided into one thousand parts, additional facility for accuracy being given by the use of three wires and the insertion (if desired) of additional resistances, to increase the delicacy of the test.

The scale in this instance is more to the back of the board, and in front of it is a stiff brass rod, insulated, on which slides a wooden or ebonite key with a knife-edge contact point and an index pointer, both in line at right angles to the scale, so that the pointer indicates on the scale the exact point at which the contact is made. The contact point is adjustable, sliding in a groove, so as to touch either of the three wires as required.

For ordinary use the short-circuiting straps are kept in between A D and F G, but when extreme sensibility is required, additional resistances are inserted at these points. The wires are so arranged that either of them alone or two or three in series can be used.

If the plug is inserted between A B, No. 1 wire only is in circuit. If B C are plugged, wires 1 and 3 are in use; while if the plug is not inserted at all, the current passes through all the wires. The only connection not at once apparent is a stout copper wire connecting C and H beneath the base.

The same remarks as to construction apply equally to this instrument and the simpler form previously described. The base, however, would look better if made of stouter material. A bolder moulding should be run round the edges, and larger terminals used.

The value of the instrument would be much increased by the addition of a lid, which might have a glass top let in, if desired, and which would keep it in a much cleaner state than would be possible without, besides making it more convenient for transit.

The batteries are inserted between D and F, and the galvanometer between E and the sliding key.

If it is desired to obviate the necessity for loose wires over the instrument, all connections may be made underneath, and carried to terminals placed at convenient points on the ends of the base.

I have not attempted to go into the theory of the Wheatstone Bridge, but would refer any reader who wishes for information on the subject to Slingo & Brooker's "Electrical Engineering," or Ayrton's "Practical Electricity," in both of which the subject is well treated. It is also considered in the "Electrician" Primers, a useful series of tracts which have been recently noticed in "Our Guide to Good Things."

DRAWER BEARERS, AND HOW TO FIT THEM.

BY DAVID DENNING.

DEFINITION OF BEARERS—OBJECT OF BEARERS—NAILING—DOWELLING—TENONING—DOVETAILING.

IT is very probable that many readers who know perfectly well what drawer bearers are may not recognise them by name, and of course, in such circumstances, to say anything about the way of fitting and fixing them would be comparatively useless. Without pretending to give any mathematically exact definition, it may suffice to say that the present paper has to do with the rails which are fixed between drawers in front, not with those which extend from back to front. If there is only one drawer, with, say, a cupboard under, the front rail separating the two is the drawer bearer, so that in a chest of, say, three long and two short drawers, there are three bearers; for though the bottom may in reality serve the purpose of one, we have nothing to do with it, as it is probably a solid board, or may be so, from back to front. The bearer then, so far as it concerns the object of the present paper, is merely the front one of three rails on which a drawer is supported, and does not refer to the solid boarding which is sometimes used instead.

It will readily be understood without insisting on the point that there are more ways than one by which the ends of these rails may be fastened into the carcase ends, and on a few of these I purpose offering a few remarks, which will no doubt serve to guide beginners in cabinet-making: or perhaps I should rather say those who have some mechanical skill, but are not so well acquainted with methods. From this it will be seen that a minute practical description of how to use the tools and do what is necessary is not in contemplation. I assume that the reader, theoretically at any rate, is acquainted with mortising, dowelling, etc., and even if he is not, he will have no difficulty in understanding the present article.

The object of bearers is primarily to separate drawers or to afford support to them, and secondly, to form a connection between the ends of the carcase, or outer casing, which they tend to hold together and render more rigid than they otherwise might be. It follows that the way they are fastened in is a matter worthy of consideration, and a few suggestions on the methods most commonly adopted it is hoped will enlarge the views of those who may have been in the habit of practising one or more, without thinking about anything more than the mechanical features of their work. It is assumed that everyone knows that the ends of a piece of cabinet work should be parallel with each other, and that the bearers should extend "square" across, or, to express it otherwise, the front opening between two ends and bearers ought to be strictly rectangular; for to those who think that the work may be done "anyhow" I have nothing to say, except that their ideas are not valuable, and that the sooner they alter them the better, if they wish to turn out good work. My remarks are addressed solely to careful workers who wish to excel.

Naturally, the simplest way of fastening the bearers in is by merely nailing them through the ends, but such a very primitive mode of working is seldom advisable, and would not be allowable in any but cheap common work. It may therefore be dismissed without further comment.

Then there is the better plan of tenoning the bearers, or the closely allied one of dowelling. Both of these are good methods, and are practised by equally competent cabinet-makers, some preferring one and some the other. Without expressing any personal opinion as to their respective merits, it will be sufficient to describe the chief characteristics, leaving readers to adopt their own course.

It is claimed for the mortise and tenon joint that it is stronger than the other, though for all practical purposes there is little difference in this respect. The tenon, or tenons—for perhaps two at each end of the bearer is the usual number—are left of the thickness of the wood, so that there is not the same risk of getting the bearers fixed other than straightly, as when dowelling is resorted to. When dowels are used, the holes, unless bored perpendicularly, will throw the bearers out of the straight line. Of course, when a really competent man is concerned, the assumption that he would make the holes in an improper way is rather a far-fetched one; but then, all workers are not proficients. With dowels it is often stated that there is greater speed and neatness of appearance, for the ends of the bearers need only be sawn square across for them to fit closely; on the other hand, those who prefer mortise and tenon do not allow that there is much difference in point of time, and that when properly done the joint is just as neat as the other. Beyond close fitting and glue, there is nothing in either of these joints to bind or clamp the ends together. The construction does not do so, for were it not for the top and bottom the ends could be pulled apart. In ordinary circumstances it is not necessary that the bearers should do more than they will if either dowelled or tenoned, but as a matter of theoretical good joinery, many may prefer that the bearers should bind the ends together, and occasionally it is an advantage to the work that they should do so. Of course, if we accept the dictum that good joinery consists in making the construction as firm as possible without using either nails or glue, it is almost necessary to adopt some other joint. Or if this is putting the matter too strongly, another form would be preferable, especially if absolute rigidity is required, rendering it practically impossible to pull the ends apart without destroying the bearers.

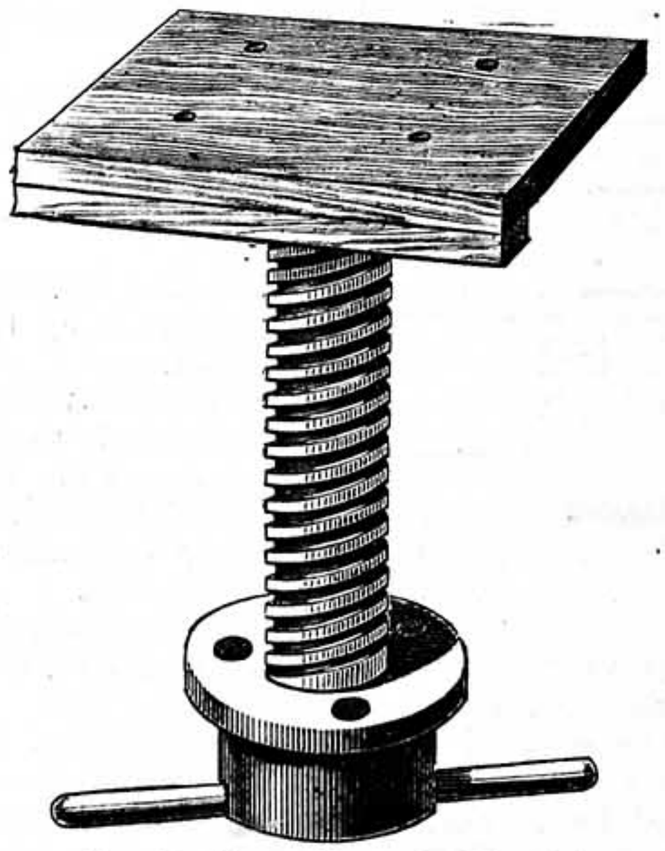
In such a joint the ends of the bearers are dovetailed, usually on the lower side only, and of course fit into corresponding sockets in the ends. In order to prevent the dovetails showing in front, they are cut back a short distance, say to the thickness of the facing slips which are so commonly employed, the sockets being stopped to an equal distance; the bearers are then driven in from the back. When the ends are thickened up in front, there is, of course, no possibility of a difficulty arising in doing this, as the sockets will only be in the thickening pieces, so that the dovetails can just be pushed into them. If the ends are of one thickness throughout, however, the case is somewhat different, as the groove must extend right to the back. When this is necessary it need not be of dovetail shape throughout, but merely in front for a space equal to the width of the bearer. For the rest of the distance it may be a plain channel of the thickness of the bearer, and will serve very well for the drawer runners to lie in. Instead of such a long groove, a

short one just behind the socket may be made, and not shorter than the width of the bearer which is let into it, before the ends are fastened up, and then pushed forward. The dovetail bearers may also be inserted from the front, if the appearance of the joint is not objected to, though even then they may be concealed by fastening facing-slips on afterwards. All this considered, if a really theoretically perfect joint is wanted, there is nothing better than the dovetailed bearers, though in practice any of the other methods are equally serviceable in most cases. The reader, however, will have little difficulty in deciding which form suits his purpose best, and with this I must leave him.

MEANS, MODES, AND METHODS.

A Suggestion for a Carver's Screw.

I do not think it is widely known, but a simple expedient to hold work while carving may be made as follows :—Obtain a music-stool screw (cost from one shilling), and a piece of any wood suitable in size for the work to be done. "Let in" the oblong plate of the screw flush to the underside of the piece of wood selected, and bore the screw-holes through the piece of wood. Select screws that will go through and project about ¼ in. beyond the top surface of the wood, and you have a useful block to



Suggestion for Cheap Screw for Wood Carvers.

fix the wood under treatment. If needful, a ledge can be fixed under the piece of wood, which, being in contact with the edge of the bench, will prevent the whole affair from turning. A hole in the bench and a turned block to which to fix the nut complete a cheap and useful carver's screw.

Several pieces of wood may be provided, and, if large, instead of screwing as advised, the piece of wood can be permanently fixed on the plate of the screw, and the carving fixed by any number of screws required round the margin. B. A. B.

A Clean Method of Brazing.

This is sometimes a great desideratum. How often has a nice piece of work been destroyed by having the fire smoky just at the time it should not be!

A friend put me up to a wrinkle which entirely did away with this possibility.

It was to heat the article by putting it into a hot gas retort from which the charge had just been withdrawn.

It may not be known to everyone that coal-gas is made by putting the coal into a large metal box, or retort, which is brought to a high temperature, and thus separates the gas from the coke of the coal. The retorts are emptied periodically, and this is the opportunity for the brazier.

Having cleaned the surfaces to be joined and tied them together with iron wire, plenty of ground borax and spelter are put on the joint, and the entire piece of work run into the hot retort. Almost immediately it gets red-hot the spelter runs, and the job is done. Of course, this plan is not available for everybody, but I have no difficulty in inducing the gas-man to let me use his retort for a few minutes. J. L. D.

Clearing Chimneys of Jackdaws' Nests.

If any of the readers of Work have had my experience in trying to clear out the masses of sticks and other rubbish which jackdaws pile into chimneys when nest-building, I am sure they will be glad of a wrinkle.

Having climbed to the top of a chimney with much fear and trembling, I spent three hours sitting on one chimney-pot, while with a heavy iron bar, used after the manner of a battering-ram, I tried to drive down a nest through the flue of another. It was all in vain. The nest, which was the result of many years' industry, resisted all my efforts, and was quite as springy and resilient at the end of the three hours' battering as before. At length, in desperation, I poured about half a pint of paraffin oil down upon the nest, and dropped some burning paper on to it. There was a grand blaze, and in a very few minutes the chimney was clear and a roaring wood fire in the grate.

This plan would not do in a city, and, of course, would be cruel if birds were in the nest. J. L. D.

MASONS' WORK.

BY MUNIO.

Staircases—Arches Used in Masonry: Semicircular, Segmental, Elliptic, Pointed, Ogee, Tudor, Foiled, and Oblique Arches—Niches—Chimney-Pieces—Measuring.

Staircases.—Stone staircases are formed in various ways. In some the flights are straight, and sometimes they are divided by landings or half-paces; but as there is not often sufficient space for straight flights, they are formed with return flights, with landings or winders at the turns. The straight steps are termed fliers, and those which are narrower at one end than the other are termed winders. In turrets the steps are all winders, with a solid newel worked on the end, or they are fixed in a central newel of masonry.

The steps are sometimes supported in walls, and sometimes one end of the steps is fixed in the wall, and the other end supported by the step immediately under it. These are termed geometrical staircases.

In order to find the form of the steps for a geometrical staircase with winders, a plan must be made as shown in Fig. 43, from which the form of the steps may be obtained.

The steps are sometimes made plain, and sometimes moulded on the edge and the moulding returned across the end, as shown in Fig. 44. The rebated joint of the steps is squared from the slope underneath, and the steps should not be less than 2 in. thick at the thinnest side. The rise of the steps should be proportioned to the width, a wider step having a less rise than a narrower one. A step 12 in. wide should have a rise of 5½ in., and a step 10 in. wide a rise of 6½ in. To find the rise, divide the full height in inches by the number of steps. To find the bevel for working the underside of the steps, an elevation of each flight must be drawn, and also each set of winders, from which the bevels can be taken.

As the stairs are not usually fixed till the building is up, it is customary to form the grooves for the ends of the steps and landings by inserting bricks in the wall without mortar, and covering them with large flat stones; the bricks are drawn after the walls are up, leaving the grooves ready formed. The steps should be inserted about 9 in. into the wall at the end, and wedged firmly in, and a dowel inserted in the rebated joint near the other end. The landing has a similar joint where it rests on the top step. The landing is generally in one stone, but when in more than one the joints should be joggle-jointed. Mortises are cut in the ends of the steps in which the iron balusters are fixed, and run in with cement or melted lead.

Arches used in Masonry.—The arches principally used in masonry are the semicircular, the segmental, the elliptic, the pointed, the ogee, the Tudor, the foiled, and the oblique arches. The lowest portion of the arch is termed the springing, the top portion the crown. The stones forming the arch are sometimes termed voussoirs; the underside of the arch stones is termed the intrados or soffit, and the top side the extrados; the centre arch stone at the top is termed the key. Arches are plain on the face, sometimes chamfered or moulded on one or both faces. Inside arches of windows, doors, etc., are generally splayed; the joints of arches are sometimes rusticated.

Arches are turned or built on wood centres, which must be of proportionate strength to support the weight of the arch stones till keyed.

In setting a range of arches the quoins should be set up first, so that the face of the arch may be kept straight by means of a line or rule, and in walling between arches, when a line cannot be stretched, each course should be bevelled. Relieving arches are formed in the wall over lintels, door- and window-heads, etc.; they should always be turned from the outer end of the lintel or head. They are generally hammer-dressed, except in ashlar-work, when they are chisel-dressed.

The Semicircular Arch.—This arch is drawn from the centre of the springing line; the depth of the arch stones is then marked, and a second circular line drawn, which gives the line of the extrados. The key-stone is then marked, and the remainder of the arc divided equally, and lines drawn from these points, radiating to the centre, give the arch stones. Sometimes the extrados are not made parallel to the intrados, but are squared to join the wall stones. Fig. 45 represents a semicircular arch, half the arch stones being of equal length, and the remaining half squared at the extrados.

The stilted arch is a semicircular arch, with the sides carried downward in a straight line below the springing till they meet the impost or cap.

The horse-shoe arch is also semicircular, with the arc carried below the springing to the cap, which narrows the span of the arch.

The Segmental Arch.—This arch is less than a semicircle, and is drawn from below the springing line. The centre is found by dropping two perpendiculars from the centres of straight lines drawn from the rise of the arch to the springing on each side; the point of intersection of these perpendiculars is the centre from which the arch is drawn. The key is marked, and the arch divided in the same manner as the semicircular arch; the arch stones are sometimes squared at the extrados.

The Elliptic Arch.—This arch is half of an ellipse or oval, and is drawn from two centres on the springing line and one centre below the line; the key is marked off, and the arch stones found as previously described. The joints of each portion of the arch must be radiated to the centre from which it is drawn.

The Pointed Arch.—Pointed arches are of three kinds: the lancet, the equilateral, and the obtuse. The lancet is formed of two segments of a circle, the centres of which have a radius longer than the width of the arch.

The equilateral arch is formed of two segments of a circle, the radius of which is equal to the width of the arch.

The obtuse arch is formed of two segments of a circle, the radius of which is shorter than the width of the arch.

These arches are generally formed without a key, although in some cases a key is used. When the extrados are not made parallel to the intrados, they are cut as shown in Fig. 7 (page 97).

The Ogee Arch.—This arch is formed of four segments of a circle, the centres of two of which are on the springing line inside the arch, the other two being on the outside and level with the point of the arch, each side being formed of a double curve, convex below and concave above. It is generally used as a hood or label mould over another arch.

The Tudor Arch.—This arch is described from four centres, two level with the springing line and within the arch, and two below the springing. The arch stones are drawn in the same manner as the elliptic arch. For ordinary door- and window-heads it is often made in one stone, with a square hood moulding over it.

Foiled Arches.—These are of three kinds: the round-headed trefoil, the pointed trefoil, and the square-headed trefoil.

The round-headed trefoil is drawn from two centres on the springing line and one centre above. It is used chiefly as a heading for niches and blank arcades.

The pointed trefoil is drawn from two centres on the springing line and two above the springing. It is generally used for foliations in tracery work, within a pointed arch.

The square-headed trefoil (Fig. 46) is used for door- and window-heads. It is sometimes in one stone and sometimes in three, as shown.

Oblique Arch.—The oblique or skew arch is that form of arch in which the line of the abutments is not at right angles to the face of the arch. Oblique arches are of two kinds—one with plane joints and the other with spiral joints.

An oblique arch with plane joints is that in which the beds of the stones are in planes passing through the axis of the cylinder, the face being bevelled.

An oblique arch with spiral joints is that in which both the beds and joints form spiral surfaces. The arch stones are set square from the face, and consequently meet the springers at an angle; the springers are therefore made wider at one end than the other, the difference being generally equal to the width of the arch stones. They are used for the arches of bridges, and are generally segmental or elliptic in form.

Niches. — Niches are arched recesses formed in walls for statuary or ornamental purposes. They are generally semi-circular or semi-elliptical in plan, although other forms are used; the arched covering is of a semi-spherical form. When the openings are small, the arch is formed with one or two stones; but when the opening is large, the arch is formed in a similar manner to the semicircular arch, except that the arch stones diminish from the front to a point in the centre at the back of the recess, and the soffit is circular. In order to obviate cutting the arch stones to a point, a semicircular boss is placed in the centre of the recess, the face of which is worked to the curve of the soffit, and the bed is radiated. Upon this the narrow ends of the arch stones rest.

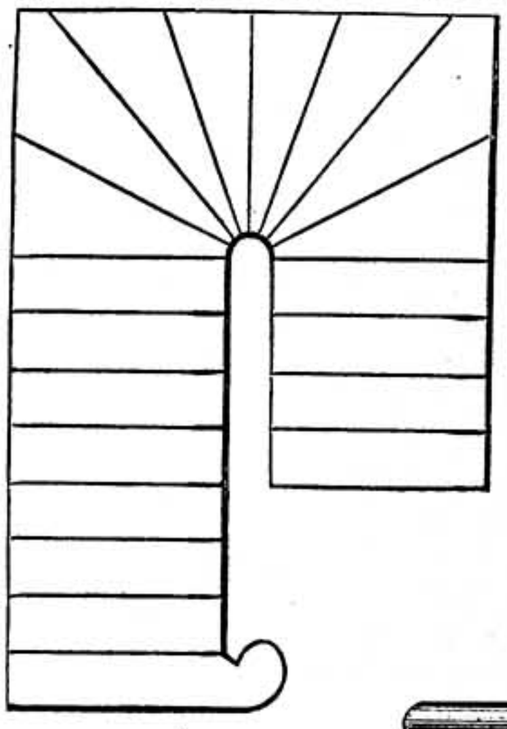


Fig. 43.—Plan of Staircase.

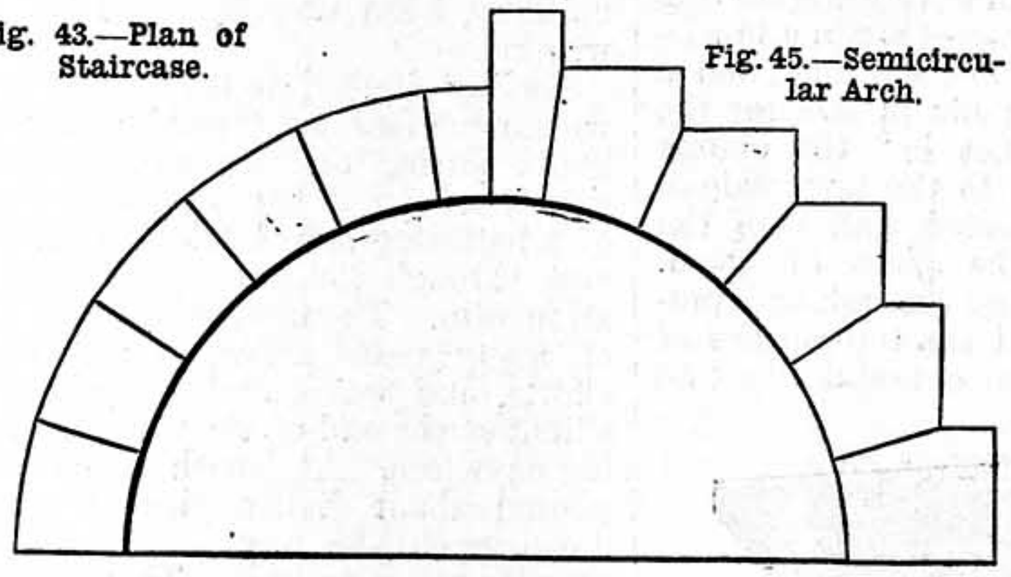


Fig. 45.—Semicircular Arch.

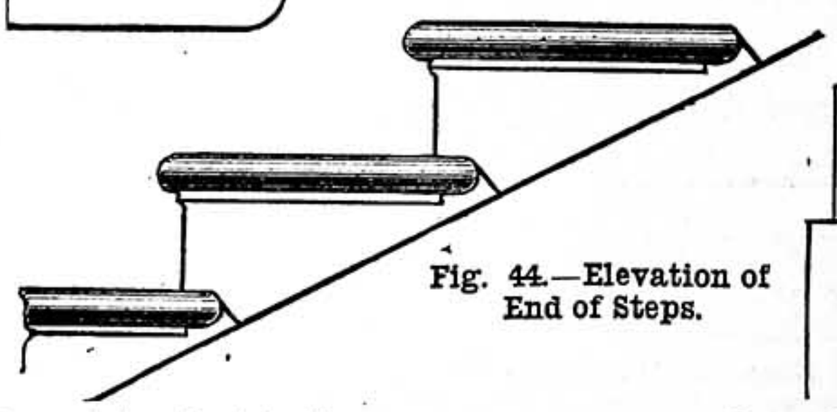


Fig. 44.—Elevation of End of Steps.

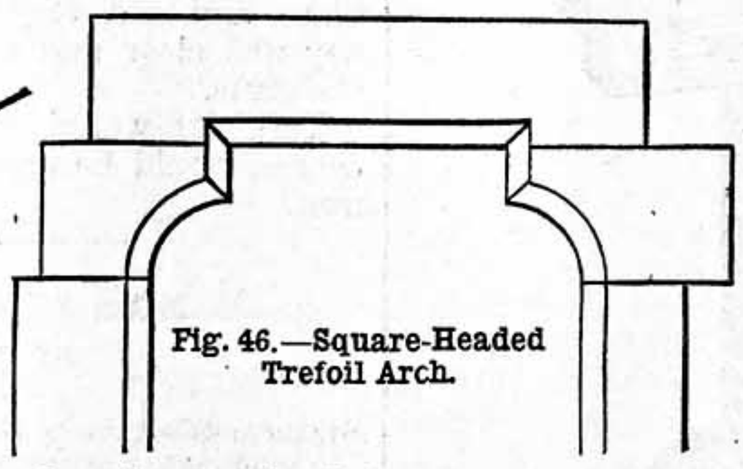


Fig. 46.—Square-Headed Trefoil Arch.

Chimney-Pieces. — Chimney-pieces are sometimes formed with solid jambs and mantels, from 6 in. wide and upwards. They are fixed in arched recesses left in the chimney breast, and the shelf is pinned into the wall; they are worked plain, chamfered, or moulded. Sometimes the jambs and mantel are formed of sawn slabs, from 1 in. thick. They are fixed by means of copper or brass cramps let into mortises cut in each stone; the shelves are pinned into the walls, and the angles are sometimes chamfered or moulded.

Measuring.—Masons' work is measured by the lineal foot, the superficial foot or yard, and by the cubic foot or yard.

Footings are measured by the superficial foot, the thickness being given.

Foundation walls above 2 ft. in thickness are measured by the cubic yard. Ordinary rubble walls up to 2 ft. in thickness are measured by the superficial yard, deducting the net size of openings.

Blocking course or hammer-dressed walling is measured by the superficial yard, deducting the openings, and giving the average width of the beds.

Ashlar-work is measured by the cubic foot for the stone, the face-dressing by the superficial foot, and the beds and joints by the superficial foot.

Reveals, splays, grooves, chases, throatings, chamfers, etc., are measured by the lineal foot.

Window-heads, sills, plinths, strings, and similar work under 9 in. thick, are measured by the lineal foot, measuring the girth for the dressing.

Arches, cornices, copings, parapets, etc., are measured by the cubic foot for the stone, and the dressing by the superficial foot. Moulded work is girthed by the tape measure, pressing it into all the members of the moulding.

Arches are girthed at the intrados and the extrados, and the two girths added together and divided by two for a mean girth.

To find the stone in an arch, multiply the mean girth by the depth of the arch stones, and this product by the length for the contents.

Paving and flagging are measured by the superficial yard, specifying the quality and thickness.

Kerb and channel are measured by the lineal foot.

Returned mouldings are measured round the ends, and the number of mitres given as either external or internal mitres.

Steps and thresholds are measured by the lineal foot, and girthed for the dressing.

Quoins are measured by the cubic foot for the stone, and the dressing by the superficial foot. Sometimes they are measured by the lineal foot in height, the size being given.

The practice of measuring varies in different districts; but it is trusted, from what has been given, that readers will understand the basis on which it is calculated.

DESIGNS FOR FINGER PLATES OR PANELS IN REPOUSSÉ WORK.

BY ROBERT COXON.

These two designs are drawn especially to assist the brass worker in producing good work in repoussé, without demanding too much labour; and when carefully traced and worked out, will be found to produce charming panels, either for the purpose of door plates, or other panel work for furniture or wall decoration.

By first carefully tracing the drawing, by means of the ordinary carbonised paper, between the brass and the drawing—using a hard lead pencil or ivory tracer—you will

TWO DESIGNS FOR FINGER PLATES OR PANELS IN REPOUSSÉ WORK.

get a good line on the brass to commence with; and having secured it by screws to a stout piece of wood, about 12 in. by 6 in. and 1 in. thick, upon which previously place a stout piece of sheet-lead between the brass and wood board, commence by marking all straight lines first with the straight tracer, and the curved ones with their respective tools. Having done which, work out, with the blunt or rounded edged tools, the leaf, scroll, and beads, using as much care as possible in modelling these, as a great part of the effect depends upon this part of the work, and finish by working up the background to leaf work and centre scrolls with their respective tools.

This work may seem, upon the effect turned out, to be extremely difficult, but, on the contrary, it is very simple, many ladies and children having produced good results from patient work; and to those who have not tried it before, it can be recommended as something novel, and producing surprisingly effective results.

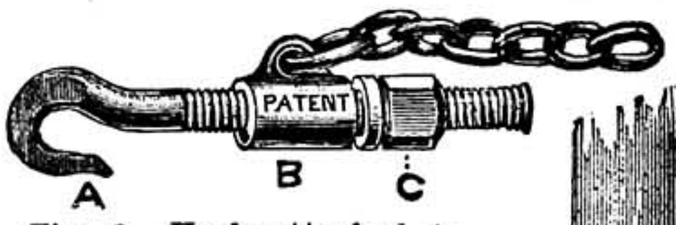


Fig. 2.—Hook attached to Scaffold Chain.

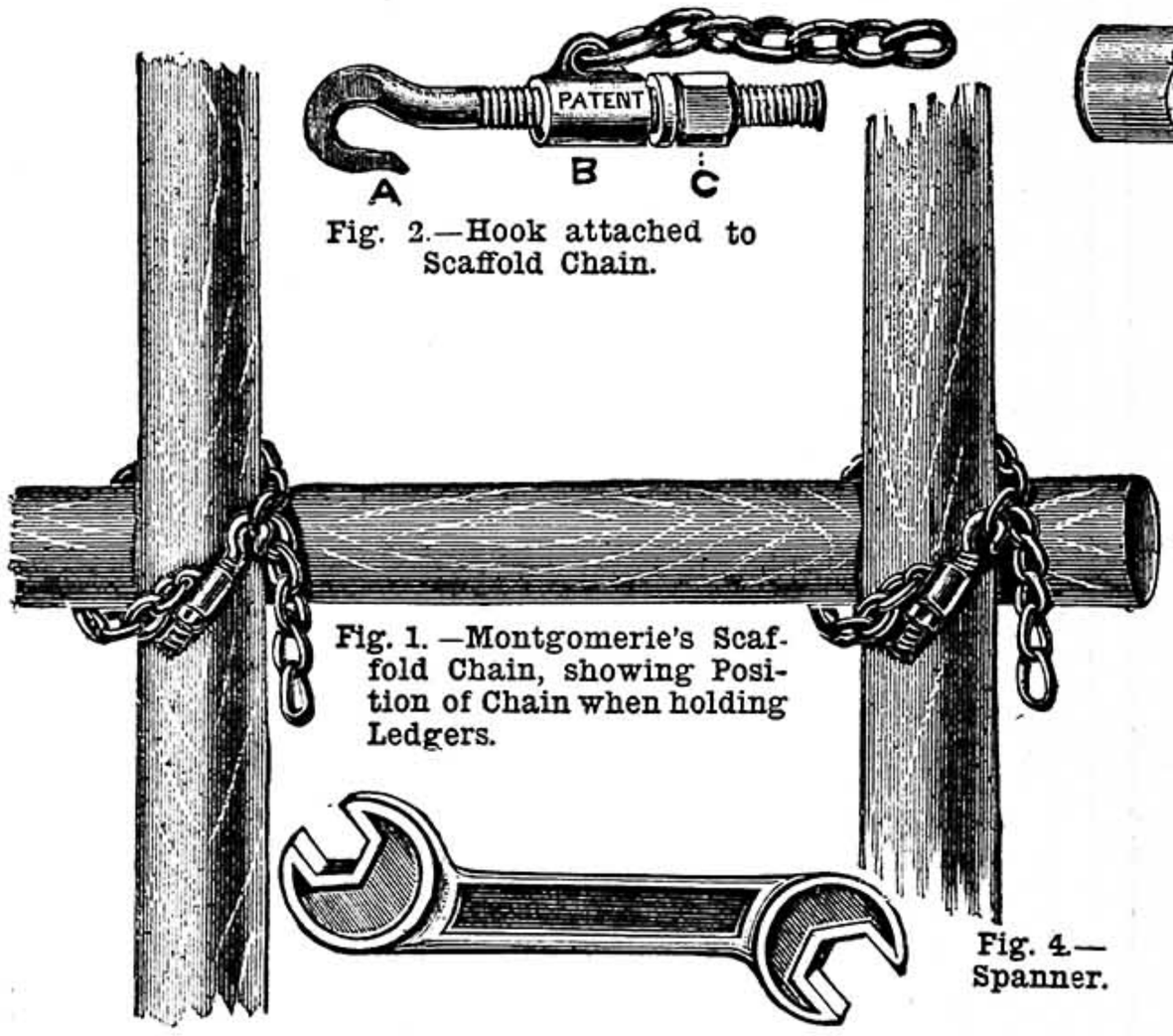


Fig. 1.—Montgomerie's Scaffold Chain, showing Position of Chain when holding Ledgers.

Fig. 3.—Preston's Improved Wrench Hammer.

Fig. 4.—Spanner.

OUR GUIDE TO GOOD THINGS.

*** Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

58.—Montgomerie's Scaffold Chain.

Everybody who has paid any attention to workmen when engaged in the work of putting up a scaffold must have noticed the way in which the horizontal spars or ledgers are bound to the vertical poles by means of ropes, which are tightened by driving in wooden wedges between the timbers themselves or between the rope and the timbers which it holds together, in order to bring the tension of the rope and its binding force on the poles to a maximum. The use of ropes for work of this kind is now rendered unnecessary for all who are ready and willing to adopt other means, by the introduction of Montgomerie's Scaffold Chain, which has been submitted for notice, and is supplied by Mr. Edward Preston, tool and cutlery warehouse, 8, Snow Hill, Birmingham. The illustration of the chain given in Fig. 1 represents the position assumed by the chain when holding ledgers, but, as it has doubtless occurred to the reader, other connections, different to this, may be made in an equally satisfactory manner. Fig. 2 shows the manner in which the chain is used. First screw the nut, C, away from the hook end, A, until it is stopped by the flat head at the end of the screw. Then let the barrel, B, with chain attached, slip down to the nut; place the chain in the position desired, and insert the hook in the link which happens to be most convenient, leaving any links beyond the one into which the hook is placed hanging loose, after which screw the nut, C, towards the hook, A, until the necessary tightness is attained. Even if the nut be not screwed up tight, the chain will not slip down, as the ledger causes sufficient strain on it, or "drag," as it is technically called, to make it hold. The chain, as is very truly asserted, has great advantages, and entirely supersedes ropes, as well as chains or short pieces of chain with a spike at each end, and enables the builder entirely to dispense with wedges for tightening ropes, which is properly regarded as one of the chief disadvantages of the present system of scaffold building; the wear and tear of the ropes, owing to the great strain put on them by the wedges, being another, and one which points to the economy effected by the use of the chain, which is rendered still more palpable by the fact that when the screw gets worn, as it will do, by frequent use, it can be renewed at small cost. Further, the strength of the chain and its durability, when compared with the rope, and the fact that the action of the screw tends to make the grip of the chain on the poles far more tight and rigid than that of the rope even when wedged up to the uttermost, clearly indicate that by its adoption scaffold accidents through collapse of the structure will be reduced to a minimum. The chains are supplied in three sizes—namely, 30 in. long with links $\frac{1}{4}$ in. thick, tested to 5 cwt., at 24s. per dozen; 36 in. with links $\frac{5}{16}$ in. thick, tested to 12 cwt., at 28s. per dozen; and 36 in. long with links $\frac{3}{8}$ in. thick, tested to 22 cwt., at 33s. per dozen. Preston's Improved Wrench Hammer, shown in Fig. 3, and combining in itself two separate tools—namely, a wrench and a hammer—sold at 5s. 6d., will be found to possess special utility for tightening up the nut; and Mr. Preston also supplies for 1s. good spanners, taking 1 in. nuts at one end and $\frac{5}{8}$ in. nuts at the other.

Another advantage presented by the use of Montgomerie's Scaffold Chain, and one which has not yet been noticed, is the saving of time effected in putting up and taking down these temporary structures, for it will be seen at once that it will take far more time to adjust, secure, and wedge up a piece of rope than it will to put the hook into the most convenient link of the chain and screw up the nut. The Editor.

SUGGESTIONS FOR WORKERS AND HINTS TO INVENTORS.

Envelopes. — Everybody knows the inconvenience of trying to introduce into an envelope just a little more matter than it will hold, while the domestic stationery case seldom contains any sizes larger than those used in every-day correspondence. There is room for a design which will suit either the ordinary note or the larger package of enclosures it is occasionally desirable to enclose. Such an envelope could not, of course, be gummed down to a fixed size; while it must look neat, no matter its spread. Such a device seems simple enough at first sight, but in reality requires some ingenuity to produce—the problem, however, being well within the range of ordinary ingenuity. As such an envelope is wanted by the stationery trade, a successful design would, in all probability, prove very remunerative.

Bicycle Tyres. — Despite the numerous patterns, pneumatic, etc., now on the market, manufacturers of cycles are asking for something which combines all the advantages of the pneumatic without its liability to be pricked so as to render it virtually useless. The solution will probably be found to be in some combination of metal and rubber, so as to render the latter independent of mere air support. All cyclists are agreed that, no matter how apparently excellent the patterns now in use, finality has by no means been reached. Whether existing lines should be followed, or a new and bold departure take their place, is a question just now exercising many ingenious minds. Meanwhile, our readers may be glad to have their attention directed to the matter.

Cycle Boots.—Apropos of cycling matters, we note that votaries of the wheel are asking for a boot or gaiter which, while not proclaiming its object so as to mark the wearer as a cyclist when walking about, shall, nevertheless, save the trouser-ends from dirt or injury. Bootmakers are (rightly) regarded as the most conservative of artisans, but, in view of the real want expressed, a suitable pattern would doubtless find a manufacturer.

Pencil and Paper.—A large number of people grumble, not merely at having to sharpen the familiar lead pencil, but even at the slight trouble involved in keeping a pencil-case lead properly protruding and sufficiently sharp. Why should not such people be suited by the invention of an almost lasting *stylus* which would at once produce a well-defined mark upon prepared paper? The old-fashioned pocket-books, with their (literally) leaden writing instruments, were a step in this direction, but they were never liked. People like to see what they have written standing out in bold black characters; and an invention of this nature would probably take.

Smokeless Briquettes.—Every now and then the invention of an absolutely smokeless briquette (which, as most people know, is an artificial compound of coal-dust, pitch, etc.) is announced by some sanguine inventor, who invariably finds that, under some unforeseen conditions, his compound is a failure. There is a large field for inventive effort in this direction, and the lucky discoverer of a really smokeless fuel will excite the envy and admiration of his friends. It need scarcely be said that an open space for experiments is a *sine quâ non* to those who would essay an endeavour to discover the much-needed substitute for smoky coal.

Anti-Scale Preparations.—Despite numerous attempts to find a really satisfactory preparation that will prevent scaling in boilers, the field is still open to anybody who can discover the much-wanted substance. Eucalyptus oil, kerosene, vinegar, the sawdust of certain woods, and an infinity of other materials, have been tried, pronounced successful, and—failed under crucial tests. Very probably this has arisen because water derived from one source requires different treatment from that derived from another. The fact undoubtedly remains that while power users in some localities declare that So-and-so's mixture is perfectly successful, people at other places find it quite useless.

SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Rate of Circular Saws.—B. A. B. (*Hampstead*) writes:—"May I say that I agree with Chopstick (see Work, No. 120, page 251), especially when he claims that for cutting thin stuff, grooving, rebating, etc., the advantages of a small circular saw are great. The great thing is to abolish 'slip.' Now, both the Britannia Co. and Barnes, of the United States of America, make circular saw benches which do away with slip, and I have no hesitation in saying that for small work, such as beehives and fittings, cameras and dark slides, book slides, and for preparing small things for turning, a hand- or foot-power circular saw, used with care and judgment, is a great advantage."

Rate of Circular Saws.—A. R. (*Scorrier Saw Mills*) writes:—"With pleasure I reply to Chopstick (see Work, No. 120, page 251). The letter he refers to in No. 116, page 187, emanated from me, and not from A Woodworker. Chopstick asks if I could get a joiner to cut 3 in. deep with a hand rip saw, insinuating that it is almost impossible to find a man to cut 3 in. deep with a rip saw. This is absurd. Within a radius of a very few miles, I could, if needed, get not only one, but scores of joiners who would rip 3 in. deep in red or yellow pine, and even deeper than that. In fact, I have seen work done with a hand rip saw which it would be impossible to do with a circular saw driven by hand. I am acquainted with several workmen who have small circular saw-benches within two miles of my residence, and the men employed at each place inform me that they prefer ripping stuff from 2 in. to 3 in. deep with the hand rip saw to turning a wheel to drive a circular saw, which they term hard labour. Chopstick may have a man who prefers turning the wheel for the simple reason that he is not a skilled mechanic. I am of opinion that nine out of ten mechanics would not accept such a job. All with whom I am acquainted prefer the hand rip saw for such work. Again, if you have a labourer to turn the wheel, a tradesman has to do the sawing, and, taking all things into consideration, I maintain that the hand rip saw in such work has the advantage. I agree with Chopstick that where there is a deal of rabbeting and grooving to be done, the circular saw bench is very useful in grooving ½ in. and ¾ in. deep. Not long since I ordered a ¼ in. grooving saw, and put it in working order for a friend who had a quantity of grooving to do, and the work was despatched in much less time than if it had been done with the plough-iron. But at the same place they preferred ripping above 2 in. deep with the hand rip saw. Again, not long ago a joiner came to me and said he had a deal of ripping to do in 2½ in. and 3 in. red pine, but his saw was cutting hollow and round. I looked at the saw, and found it was slightly bent. I sharpened and straightened it for him, and met him a day or two after, when he said (using his own words) 'he had been ripping two days with it, and it went *grand*.' Again, I pass a shop daily where there is a small circular saw bench, and if you were to go into the shop you could not see the bench, because it is buried with waste timber; and if they have not time to bring the timber to our works to be sawn, they rip it with the hand saw. A circular saw by hand in certain work is not work for a man; but I think the above will fully confirm my argument on page 187, Vol. III., of Work."

Varnish.—H. L. (*Urmston*) writes:—"Referring to your reply regarding varnish to J. T. (*Nottingham*), in your issue No. 121, page 268, I have used a cold lacquer made by the Dalton Manufacturing Company, whose offices are at 12, Peter Street, Manchester, which I have found excellent for all kinds of metal. It dries quickly and becomes perfectly hard, and entirely free from the stickiness mentioned in your reply. It requires no heat or other preparation, and can be used by anyone. They make it pure crystal, also black, and in a great number of shades, all of which are transparent. It can be bought in shilling bottles, also in large quantities."

Gilding on Glass.—T. W. V. (*Leicester*) writes:—"Having seen both H. L. B.'s and Blinker's answer to Young Signwriter (see Work, No. 121), with all respect to your correspondents, I may say that their description of gilding on glass is not the practical method. Having at times seen hints in Work that have been very useful to me, I would like to give Young Signwriter, or any other aspirant in glass gilding, the practical way of doing it. This work is usually done on shop windows. Mark the design on the outside with wax, then go inside and clean the window. When this is done, size in the letters (size with spirits of wine is best—see H. L. B.'s instructions in Work, No. 112). There is no need to be particular in the cutting in with size, but it is advisable to have as little size as possible in front of the leaf. Only size a letter or two at once. When the gilding is completed and dry, see to all pin holes. Then with japan black line the letters in (you will be able to see the wax line through the gold leaf). It is best to size the gold before blacking, but it is not necessary to do so. When all the letters are written, let the black dry; this will take only a few minutes. Clean out your brushes while this dries. Then, with a little warm water and sponge, wash all over the letters and window, and the gold outside your letters and size will come off. I will give a further bit of valuable information to the glass writer. Get some clear varnish and line ⅛ in. outside the letters, which will protect them from water. If you should prefer a stencil (which is very useful for facias), cut the letters out of paper, and stencil the black on gold leaf instead of writing with a brush."

II.—Questions Answered by Editor and Staff.

Monogram for Illuminating.—A. C. (*Leicester*).—The following monogram, E. E., is in answer to the request of A. C. (*Leicester*). This correspondent omitted to mention the object for which his design was intended. This should always be

E E Monogram Design.

stated, as monograms for different purposes require different treatment. For instance, one drawn for fretwork, if used for illuminating, would present a very wooden and clumsy appearance, and *vice versâ* the result will be equally inartistic, therefore unsatisfactory.—A. C.

Hall-Marking.—J. H. W. (*Homerton*).—I fear that it is not possible to re-hall-mark your ring, but you can judge for yourself from what follows, and if you decide, after all, to have it done, the Editor will, on receipt of a note from you, endeavour to give you the name of a manufacturing jeweller who would do the job—that is, always providing that you do not know of anybody yourself in the line. First, then, you should know that it is necessary to obtain at least 12 grains of the gold from the ring itself, for the purpose of obtaining by assay the proportion of fine gold that there is in the article. That matter, however, is carried out at the Goldsmiths' Hall; but you could not take it there yourself, for no work is received unless by firms that have already registered their name-punch. The hall-mark, being a trustworthy guarantee, is not placed on any work without a thorough test. So to prevent any cheating, the ring has to be cut open to show that the quality is the same all through, and it is partly laid flat to allow of the marks being struck. The authorities at the "Hall" have the right of scraping or filing or cutting the quantity of gold required from any part they choose of the work sent in. Now, in this case, where the ring has been in bad hands, it is very doubtful if it would once more pass the Hall; for even if the new piece put in is fully 15-carat, there will probably be more solder about it than there should be, and so the general quality will be lowered. The Assay Department of the Goldsmiths' Hall has the power of smashing any work that does not come up to the stated quality, although now I do not think they do so in all cases, but return it unmarked to the sender. I said that I would try and find somebody to do this job for you, but it is a very unthankful business; for no manufacturer likes to have his work sent back through being of inferior quality, nor will they run any risk of it, as a rule. It is almost a pity that you did not get skilled advice on this business, for then the dishonest jeweller who tried to pass off a piece of base metal in place of your gold could have been made to pay for his trickery; and I should be quite willing to have helped you to make him smart for damaging your ring and attempting to rob you of a portion of its gold. Thus, you see, to re-hall-mark the ring is an unsatisfactory job to take up; and even if successful it would cost from 5s. upwards before the ring is again in fit condition to wear. The hall-marking of a portion is distinctly forbidden. If you desire to know if it is 15-carat gold that has been put in, nearly any jeweller ought to be able to tell you that; but if you desire an authoritative opinion, you can obtain it from Messrs. Johnson, Matthey & Co., Assay Office, Hatton Garden, by sending 1s. 6d. and cost of return postage, with a request for them to make a "parting" assay of the back part of the ring. It will, as I have already said, damage it somewhat, for the half-pennyweight requires some scraping to obtain, and it would be simpler to cut a piece right out, which they very likely would do.—H. S. G.

Reflecting Telescope and Eye-piece Lenses.—E. G. S. W. (*Weybridge*).—I am glad to learn that your speculum defines well. Of course, you know that by using it without a flat you simply form an Herschelian telescope. In selecting the plate-glass for the experimental "flat," try and get a piece of an old good mirror—more care is likely to have been taken in the original polishing of such glass. The scratches on the eye-piece lens should not matter much for preliminary tests; and I fear the price asked by Wood, of Cheapside, is the price any optician will ask. I wrote on your behalf to Messrs. Lancaster & Son, of Birmingham, and their catalogue is likely to be of use to you or any other amateur. They express their readiness to supply any kind of lenses that may be required. The price they name for lenses for eye-pieces is—for low powers 3s. each set, and for high powers 4s. each set. The latter price, you will see, is the same as that asked by Messrs. Wood. Perhaps some reader in actual touch with the trade will come to our assistance, and tell us if reliable lenses for astronomical eye-piece work, edged and centred, can be obtained anywhere at a cheaper price than that given above. The firm I previously referred you to has, as you say, ceased to exist. I should strongly advise you to make an effort to buy from an old-established maker one complete eye-piece of medium power (say, 150 equivalent). This should cost you from 10s. to 12s. 6d., and, possessing it, you could be quite sure that any observed error must be in the speculum. This, as you will by this time know, means more than it sounds.—E. A. F.

Upholstery.—F. W. R. (*Harling*).—I am afraid it is useless to give you names of firms dealing in the class of articles you want, for if you cannot see them in the pages of the periodical you mention, I am almost sure you would overlook them in Work. I do not think there is anything commonly used in the upholstery trade which is not advertised by some firm or other, and to make a selection between the merits of competing houses is not our province. Of course, you cannot expect each advertiser to give a complete list of all the articles they deal in, but you can surely use your own judgment, even if you have no personal knowledge of the trade. Thus, if you see a man advertising general hardware for cabinet-makers, etc., surely it will occur to you that he would be a likely one to apply to for tacks, gimp-pins, studs, etc., even though he does not say in his advertisement that he supplies these. To give you a complete list of everything used would take up more space than can be spared; but if you cannot avail yourself of the above hints, let us know, and state exactly what you want, and you will be helped. At present, even among those things you name, you are too indefinite. For example, you mention "stuffing materials." Do you mean hair, flock, wool, alva, fibre or other stuffing, or all of them? Then, do you want blind materials, bedding, and so on? Really, if inquirers knew how much more definitely they could be answered, they would not hesitate to be more explicit than they are. If it is worth while for the publishers to place at their disposal several columns of "Shop," and for members of the staff to devote their time and experience to answering questions on any branch of practical work, it ought not to be too much trouble for inquirers to tell us what they want to know. Too many, like yourself apparently, seem to think that the vaguest hints as to their difficulties and wants are sufficient to enable us to help them. If you and other readers will kindly note these remarks, and act on them, you may be sure that no trouble is spared in endeavouring to assist; but if you cannot state your wants, it seems hardly fair that valuable space and time should be taken up in giving you the attention expected. Inquiries cannot be answered privately through the post.—D. D.

Fretwork Patterns.—D. B. J. (*Dalbeattie*).—I am sorry that I cannot agree with your complaint that fretwork patterns are too dear. You must remember that the publishers must pay for designs, labour, and incidental expenses, as well as make a reasonable profit. Good designs and work cost money. The one you forward as a specimen of cheap work may be satisfactory to some fret-cutters, but I cannot imagine anyone who knows anything of design, or who is able to do good work,

wasting time and material over it. This is far from saying that it is not worth the money charged for it, for the price being so low very little can be expected; but it is in no way better, or even such good value as many of the most expensive designs which are issued. You might as well complain of wood, glass, hinges, and the other items you name being too costly to allow of your making a profit on your work as of designs. Of course, you are aware that when making up fretwork articles, especially if for sale, it is not economical to use a printed pattern for each, but is better to take a heelball rubbing, or adopt one or other of the well-known processes for reproducing designs. You want to know where you can get patterns for less than 2s. 6d. each; but as you have several catalogues, I am afraid you have not looked through them, for I do not know of any—and I am acquainted with all the chief ones—which has not several under this figure. However, to give you names, I may mention those of Harger, Settle; Skinner, East Dereham; Zilles, London; Busschotts, Liverpool. The latter two supply principally German and Italian designs respectively at low prices.—D. A.

Camera.—A. W. (*Paisley*) forgets that his very abbreviated descriptions are somewhat difficult to follow. He can scarcely expect any criticism on anything that is not actually explained; and that such and such things *may* be made in other ways than described, in order to meet objections, is altogether outside the question. Has A. W. actually made a working instrument according to his diagrams? If not, we should advise him to do so; for a thing may seem all right on paper, but in reality be very different. With regard to his box to be used as a dark tent, it seems to us inconvenient and unnecessary in these days of dry plates, when development is seldom or never done out-of-doors, and indoors a larger working room is desirable. With the wet collodion process, something of the kind was essential, and Edwards brought out his Graphogenic apparatus to meet the want where the development was conducted in a ruby glass box. Practically it was a failure, although no trouble was spared in the manufacture, and every supposed requirement was met. We can only reiterate that A. W. had better make the apparatus and try it, or let some *practised photographer* do so, in order to estimate its working value correctly.—D.

Leclanchè Battery.—D. A. R. (*Stockton*).—Your "electric battery" is known by the name of the Leclanchè battery. In answer to your questions—(1) The outer jars are charged with a mixture of sal-ammoniac and water. Sal-ammoniac dissolved in water until the water will dissolve no more. This is named a saturated solution. Dilute this with one-third more water to form the battery solution, and fill the cells to within one inch of their tops. (2) This charge may not need renewal for three years, or it may only last three weeks if the bells are rung continuously, or the circuit leaks. (3) You may compare the battery to a cistern of water if you choose to do so. You will then understand that you can get no more out of it than you put in the cells; but do not imagine that the electricity runs out as a liquid, and therefore empties the battery jars of the liquid with which they were charged. The liquid sinks in the jars because the water of the solution is evaporated and passes into the air. This takes place more rapidly in warm weather and in warm situations than in cold, hence the battery should be kept in a cool place. One jar may be warmer than the other, and this may cause "the water to disappear from it in much less time than the other." There is much less surface of zinc exposed to the solution when the jars are only half full, consequently there is more resistance in the battery, and less current available for the bells. As the battery does not furnish enough current to ring the bells, they stop ringing. Always keep the solution up to its first water line by adding a little rain water occasionally. (4) The "jars may be worked out" with a year's use if this has been excessive or the circuit has leaked. A Leclanchè battery is "worked out" when the peroxide of manganese in the porous cells has given up all its free oxygen and passed into the form of a sesquioxide. Take out the porous cells and soak them in warm water for two or three hours. Clean the zinc rods and the outer cells, then charge the battery with a fresh sal-ammoniac solution. If the battery works all right after this, the porous cells are not worked out. (5) Two small jars ("1s. 3d. size") are barely enough to ring even two small bells.—G. E. B.

Black Stain. — LITTLE JIM. — What kind of bracket is it? If it is of wood, then why wish to make it like black marble or enamelled-slate timepieces? To use this effect successfully, your bracket must be devoid of ornamentation. In any case, if you wish a very *lustrous* black, use black enamel upon a coating of flat black paint. A less brilliant surface would probably look the best, for which ebonise and then French polish. Refer to Index, Vol. II.—F. P.

Aquarium Fountain.—J. P. (*Edinburgh*).—An illustrated article upon the above will appear in WORK in due course, but, pending its appearance, if you are in a hurry, you might with advantage study the description of a Self-acting Fountain in No. 69 of WORK. If you look at the diagram illustrating the working of the fountain, you will see that *the depth of the basin* would be the only material alteration required to make that particular design answer for an aquarium—the jet-pipe and filling-plug, of course, being raised to the necessary height. As to any fountain being "self-feeding," that is simply an idle wish. The only advantage in trying to make one that I know of is the certainty that the worker would leave the job much wiser than he started.—C. M. W.

Bell-Ringer's Table.—RINGER.—I give a sketch of a simple portable table which I have designed to fold up into the space required, viz., 3 ft. long and 1 ft. 8 in. wide, to be used as a handbell-ringer's table. It is composed of eleven pieces when complete, as the following:—Four pieces hinged in centre to form top, size when folded 2 ft. 9 in. by 1 ft. 6 in. (see Fig. 5); these pieces should be properly framed-clamped to make them flush on both sides; they will also be lighter made this way than if they were clamped with battens, for you can hardly have the top out of less than 1 in. stuff. Two pieces hinged in three places to form long rails out of 3 in. by 1 in., as in Fig. 4; these are secured to the uprights with thumb-screws. Two pieces hinged in five places to form struts or stiffening pieces, secured to the long rails,

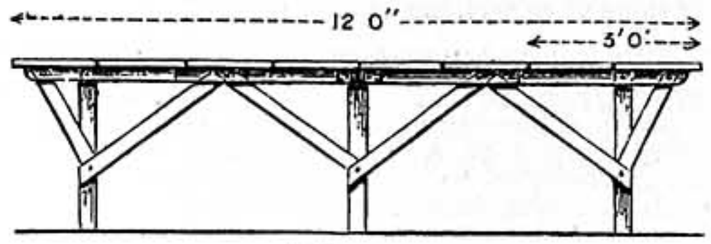


Fig. 1

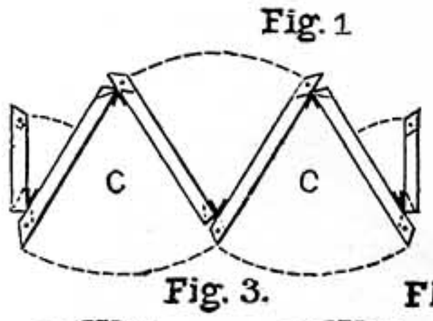


Fig. 3.

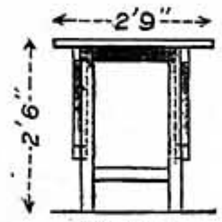


Fig. 2

Fig. 5

Fig. 4

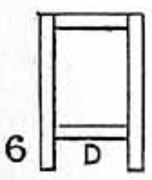


Fig. 6

Bell-Ringer's Table. Fig. 1.—Elevation of Table. Fig. 2.—End View. Fig. 3.—Struts, showing Method of Hingeing. Fig. 4.—Front and Back Rails, showing Method of Hingeing. Fig. 5.—Flaps. Fig. 6.—Framed Support.

A, and the uprights, D, with thumb-screws (see Fig. 4); and three framed uprights, Fig. 6, with 2 in. legs and 2½ in. by 1 in. rails, making eleven pieces in all. The method of putting the table together is as follows:—First stand your uprights in position, open your two top rails, and connect the top rails to uprights with thumb-screws; next open your two stiffening pieces, which are halved behind the rails and in front of the uprights, and fix those in the same manner. These stiffening pieces should be 2 in. square, to allow of them being halved 1 in. behind rails and 1 in. in front of uprights. Now screw the four leaves directly on to the top of long rails and uprights with coarse wood screws; and, if properly made, I think you will find you have a perfectly rigid table, which I hope will suit you.—E. D.

Pencil-Sharpener.—J. M. (*Dorset*).—The knife-chisel pencil-sharpener which you forward is an ordinary knife cut in half crosswise, the piece remaining attached to the handle having the narrow edge caused by the severance sharpened in the manner in which a chisel is treated. I have given it an active trial for several days. I still prefer the method described on page 697, Vol. II., No. 95, of WORK. I have suggested one or two points as improvements. Your idea is certainly an excellent one for those entering a draughtsman's office, or for those who may not have become used to any other practice; and as you say you are an invalid, and wish to utilise the invention profitably, I should advise you to communicate with the different tool makers who advertise in WORK.

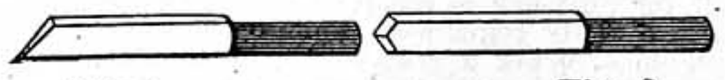


Fig. 1. Fig. 2.

Pencil-Sharpener.

The publication of this reply, of course, offers to all the opportunity of making a chisel-knife pencil-sharpener; but you must bear in mind that this will be the means of testing its usefulness, and, if found of service, this should be a very good reason for the wholesale manufacture of such an article, and the inducement of some firm to take the matter up. I will explain why I consider the adoption of my sketches as improvements on your sharpener, which has a chisel-edge at right angles to the long edge. First, I must say that the way to sharpen a pencil is to hold it firmly upon a board, and use the chisel-edge, cutting away from the operator. During these movements it is difficult to retain the edge parallel with the surface of the board, the consequence being that the right-hand corner of the knife digs occasionally into the board. With a chisel-edge as in Fig. 1 this is obviated.—J. S.

Spindles.—J. P. (*Woolwich*).—Like you, I have to send to the centres of the cabinet trade, and find Banks, wood turner, of 65, Holywell Lane, and Lyssow, of Old Street, suitable men for spindles and turnery goods. Lyssow sells bone knobs and carved panels, and a good assortment of other fittings. For ironmongery and brass work, H. Snuggs, 331, Old Street, E.C., is excellent—very large stock and moderate prices. While writing, I might tell J. P. that for veneers, stringing, marquetry ornaments, etc., McEwan, 282, Old Street, E.C., has been of great service to me when I have had repairs to do in ebony, ivory, etc.—B. A. B.

Fretwork Patterns.—H. R. (*Manchester*) desires a pattern showing a farmhouse. If any such is in the market, it is probable that he could be helped to it by applying to one of the large dealers in such things, such as Messrs. Zilles & Co., 21, Wilson Street, Finsbury, London, E.C.; Messrs. Harger Brothers, Settle, Yorkshire; or Mr. G. Busschotts, Park Lane, Liverpool.—M. M.

Fine Lines in Fretwork.—G. T. N. (*Finsbury Park*).—Mention was made in an early number of WORK of a *wire-thread fret saw*, introduced by Messrs. Richard Melhuish & Sons, 85 and 87, Fetter Lane, E.C. This is merely a steel wire jagged with saw teeth, and it would, I imagine, help G. T. N. out of his difficulties. One of his troubles is that the hole necessary to admit an ordinary saw spoils the effect, and this saw, of course, would require a relatively small hole—no larger, in fact, than the width of the cut. If Messrs. Melhuish are prepared (as they doubtless are by this time) to supply customers with wire saws of different sizes, they can probably supply suitable drills to use with them.—M. M.

Damaged Dulcimer, etc.—A PLAYER.—Please don't apologise for "any trouble you may give." The fact of such an experienced hand as yourself asking for advice is a striking proof that WORK is what it aims at being—viz., "a journal for *all* workmen, professional and amateur." You can certainly put a new soundboard in your dulcimer without pulling the instrument all to pieces, and to do so proceed thus:—Remove the damaged one by taking out the beading or moulding that runs all round; do this, if possible, without breaking it, as the same moulding will do again. Then bore a hole of about ¾ in. diameter at each corner close up to the blocks, but ¾ in. from the front and back; this will clear the braces. With a small saw you can now cut from one hole to another along the blocks, and also as far as the inner treble bridge at back and front. Here you had better stop, and commence again on the other side of the bridge, and so continue to the bass bridge. Having gone quite round, you will be able to remove the damaged board without trouble. Now remove the pieces that have been left on the tops of the braces, being very careful over this, or you will splinter the veneer from the tops of the facings. Then trim off the sides level with the blocks, leaving the grooves filled with the edges of the old board. You will not be able to fit the new board into these grooves, so you must get out two fillets ¾ in. by ½ in., and glue and brad one on each block, with its top edge exactly level with the *bottom* edge of the groove, and also with the top edge of the brace. You will now have a rebate all round, on which your new soundboard will rest. You say the old one is of cedar—I suppose you mean the scented or pencil cedar. By all means put in a new one of the same kind of wood if you can get it, but if not, put in one of pine. Having carefully fitted it, remove it and clean it up to the exact thickness of the old one; then cut the sound-holes and polish it. If of cedar, polish it in its natural colour; but if of pine, polish it black. It is now ready for fixing. To fix it, it need be only fastened with ¾ in. brads all round—brads about 2 in. apart. If you have been able to remove the moulding without breaking it, you can now replace it, and having put in the sound-hole rings, the instrument will be ready for re-stringing, after which it should be "as good as new." The second instrument about which you inquire, and of which you send a sketch, is a "bow or streich zither." It appears from your drawing to be a pretty good one. I presume the frets and stops are only approximate, as if they are copied exactly from the finger-board, it is incorrectly fretted. It should be strung as follows: 1st, No. 7 steel; 2nd, No. 8 steel; 3rd, No. 8 brass; 4th, steel overspun with copper. It is tuned the same as the violin. As its name implies, it is played with a bow, and should have on the underside three feet, with a small sharp spike in each, which serve to keep it steady on the table. As a rule, the tone is very poor and thin, and the instrument is being supplanted by the "viola zither" and "Philoméle."—R. F.

Provisional Protection. — PROTECTION. — If, under the circumstances named, B should attempt to obtain a patent, he can be opposed by C on the ground of his having obtained the invention from him. If, however, B has got a provisional protection granted to him before the date of A's application, and his title and provisional specification are wide enough to cover the plans of A, then it will be difficult for him to get redress. If it happens that A is before B, and completes his patent, B will be unable to use his improvements, except under a licence from A. It would be necessary, however, before either party proceeds against the other for an infringement, that he should possess the sealed

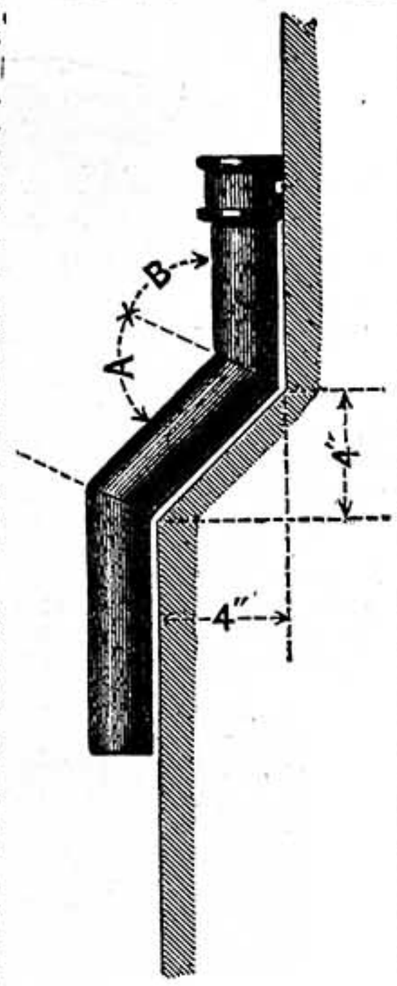
patent, as, until he has got it, he has no tangible rights to fight for, or to be infringed. Provisional protection merely assures him that no later applicant shall go before him in obtaining the right he seeks.—C. E.

Invention.—PATENT.—The extensive ignorance of the public in all matters relating to patents is very lamentable, and this is maintained and very greatly increased and rendered more difficult to enlighten, by the labours of, and opinions promulgated by, inexperienced, ignorant, and incapable amateur dabblers and others, who are so constantly found thrusting themselves forward with their crude and ignorant ideas and dangerous and ridiculous "advice" on the subject. The cost of a patent, like that of any other work requiring the exercise of skill, education, and experience, must entirely depend on the amount of work to be done in preparing proper documents and drawings. The Government fees do not—as the ignorant and inexperienced inventors or intending patentees so fondly imagine—cover any more than the charges at the Patent Office: in fact, they simply represent the stamps on a title-deed, a mortgage, an agreement, a lease, or other document which requires to be of a legal character in order to obtain legal support. An inventor or intending patentee may, of course, if he so chooses, do his own work himself and put in the papers he has prepared—just as a man may be his own lawyer, his own physician, his own architect, his own engineer, his own builder, or do any other work of the kind—and then the charge at the Patent Office for recording his application is covered by the £1 stamp, which he must have impressed on his petition. Then at, or before, the end of nine months from the date of his application he must file a complete specification and drawings, etc., embracing all the particulars required by the law to be done, to make a document the law will support, and on this there must be three impressed stamps of £1 each, so that when the patent is granted he has obtained what is generally considered by most inventors to be "a valuable exclusive privilege"; and all this, under these circumstances, for the moderate sum of four pounds! This will hold good for four years from the date of his application, at, or before, the end of which period he will have to pay the sum of £10—which will keep up the assumed right for another year; and at, or before, the expiry of the sixth year he must pay another £10; and in the same way each year up to the eighth, when the payment is raised to £15, which has to be repeated; and before the expiry of the tenth the payment is raised to £20, which has to be repeated before the expiry of each succeeding year it is desired to keep the patent in force until the thirteenth year is reached, when the last payment covers the fourteenth year; at the expiry of which the patent comes to an end, and then becomes the property of the public, unless an extension is obtained. If preferred, in place of the above, £50 may be paid before the expiry of the fourth year, and £100 before the expiry of the eighth, which payments keep the patent in force for the full term of fourteen years. We should never advise an inventor or intending patentee to trust to his own unaided exertions in preparing the title, documents, and claims required by the law to define his invention; nor would we advise him to trust himself in the hands of anybody but a really skilled, respectable, and capable adviser. At the present time we are swarmed out with a host of persons undertaking to "advise" inventors, and prepare their specifications, drawings, etc.; not a few of whom will be found to be foreigners—Jews as well as Gentiles—and whose thorough acquaintance with the English language, and the English patent law, must be obvious to any person of the least comprehension. Of what good is a useless and invalid patent to anyone, even if it is a gift? and if PATENT is an admirer of such things, he will be most successful in obtaining one by doing the work himself.—C. E.

Negative Varnish.—C. G. (*Putney*).—A very good negative varnish may be made by mixing one part of best white hard spirit varnish with two parts of methylated spirit and straining. If this is found to be too thick, add a little more spirit. It is rather long in hardening, but is, otherwise, a very good protection varnish. Another popular recipe is—to six ounces of best orange shellac, two ounces of sandarach, powdered coarsely, and mixed with as much roughly powdered glass (this is merely to expedite the solution by keeping the particles of gum separated), to a gallon of cold methylated spirit. Shake up daily for a week, let it stand to settle for a few days, then pour off the clearer portion and filter. This makes a rather dark-coloured varnish, but a very good and hard surface. Of course, with both kinds the negative requires warming *slightly* before and well after the application.—D.

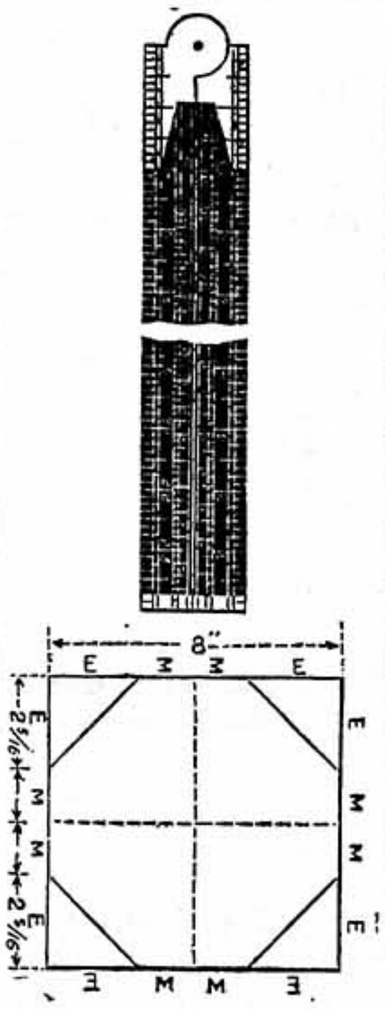
Illuminating Addresses.—GUGLIELMUS.—All materials for illumination are to be bought from the larger artists' colourmen, such as Brodie & Middleton, 79, Long Acre; Lechertier, Barbe & Co., Regent Street; and Winsor & Newton, Oxford Street. The sizes and prices of vellum at the first-named shop are—10 in. by 8 in., 1s. 9d.; 14 in. by 10 in., 3s.; 16 in. by 12 in., 4s. 6d.; 18 in. by 14 in., 5s. 9d.; 25 in. by 19 in., 10s. 6d. I am not acquainted with any published designs for these things, the illuminator generally arranging his own design so as to be emblematical of the circumstances under which the address is presented; but if there are any such things in the market, they will be met with at such shops as those mentioned above. I believe that Martin Billing, Son & Co., Livery Street, Birmingham, print and sell vellum for the purpose with a border in *type* ornament, printed in two colours.—S. W.

Pattern for Down Pipe over Plinth.—J. G. (*Glasgow*).—If an order came to our foundry for a pipe to pass over the return plinth, such as you draw, having a 4 in. projection and a 4 in. rise, I should simply draw it and the pipe out to full size on a drawing-board, measure the angles A and B, and, setting a bevel to them, cut the pipe ends to suit. This is as simple a job as one can have. If I have misunderstood your query, please make it clearer.—J.



Rain Pipe.

Carpenter's Rule.—W. I. C. (*Tavistock*).—The eight square lines, or the lines marked E M (see diagram of rule), are for the purpose of converting a square into an octagon or eight-sided figure. For instance, if the square below is 8 in. square, and you want to turn it into an octagon, look down the line E on rule until you come to 8, then the distance from the outer edge of rule to 8 on the E line is the distance from each corner of the square to the points of the octagon, viz., $2\frac{5}{16}$. In exactly the same manner, if the side of the square measures 9 in., 10 in., 12 in., or any other size up to 36 in., the length from the corner or angle of square to the points of octagon is found on the front edge of the rule opposite the length of side of square on line E. The figures on the line M give exactly half the length of the side of the octagon required. If you now look at 8 on line M, you will find it is exactly $1\frac{11}{16}$ in. from the outer end of rule, which is the length of half the side of the octagon. This can easily be proved by a little attention. For instance, the side of our square is 8 in., the length from corner of square to point of octagon is $2\frac{5}{16}$ in.; therefore, if you add the two $2\frac{5}{16}$ in. together, this will give you $4\frac{5}{8}$, and the difference between $4\frac{5}{8}$ in. and 8 in. is the length of one side of the octagon, viz., $3\frac{3}{8}$ in., the half of which is $1\frac{11}{16}$ in. as above. Similarly as this line M gives the half of one side of an octagon, it also gives the means of determining at once the size of the piece of stuff required to get out an octagon on any given size. For example, divide the length of the given side by 2, find the result on edge of the rule and the size opposite on the line M, it will be the size of the piece of stuff required. For instance, an octagon is required with its faces each 12 in. $12 \div 2 = 6$, then find 6 in. on the edge of the rule (that, of course, is opposite 15 in.), and the size on the line M is the size required to get the octagon out of. There are sometimes three teeth on a carpenter's mortise gauge, two on one side for mortises, and one on the reverse side to enable the tool to be used either as a mortise gauge, or a single tooth or ordinary gauge. The majority of carving tools are sharpened in the way described in your letter.—E. D.



Carpenter's Rule.

Polishing Rosewood and Inlays.—S. S. (*Salford*).—As you can already polish plain surfaces, you ought to experience no difficulty in polishing the rosewood inlaid work. If you omit the "filling," which you seem to think is so necessary, especially if the work is well cleaned off and glass-papered quite smooth, it might be wiped over with a little clear linseed-oil, but this is a matter of choice. Instead of the usual brown polish, as made from orange shellac, use what is known as white or transparent polish. It will be necessary to give a few extra rubbers of polish in place of the "filling in," and it will be found an advantage if you give the work a few taps occasionally, as the "bodying in" proceeds, with a little powdered pumice tied up in a piece of rag or very fine muslin. It helps to fill up the grain and grind the polish to a level surface. The mahogany inlaid work will require a somewhat different procedure. As you wish to darken the mahogany, the light and coloured stringings must be protected by carefully coating them over once or twice with white polish, or equal parts white polish and white hard varnish, applied with a camel-hair brush, taking care not to put any on the part you wish darkened, as it will prevent the stain striking in. When this is dry, apply your stain, which, when dry, may be oiled and filled in if desired, but can with advantage be omitted. Unless you feel sure the inlays are well protected when polishing, give two or three good wet rubbers of polish to set the stain. When quite dry, glass-paper quite smooth; then body up, using pumice as advised. You will perceive that if the mahogany had been carefully selected as regards colour, or stained previous to using, the process of polishing would have been much simplified.—LIFEBOAT.

Telescope.—GANELON asks if articles have appeared on the construction of microscopes and astronomical telescopes, and, if not, for the necessary dimensions. If GANELON will procure Nos. 22 and 23, Vol. I., of WORK, he will find full instructions for a good microscope designed expressly for the readers of WORK. It has been a matter of gratification to the writer of the articles to know that the readers of WORK have in several instances worked from the design, and have expressed great satisfaction with the result. As far as I am aware, details for the construction of a telescope such as GANELON desires have not been given. I would just say that a 4 in. achromatic is rather an expensive O. G. to try one's skill upon as a first effort. However, I will give such brief information as is adapted to "Shop." The body tube may be about two-thirds or four-fifths of the focal length of the O. G., which we presume will be about 60 in. At a distance of half of the focal length of the O. G., a stop must be placed with an aperture of 2 in. The full length of the focus must be made up by a smaller tube to carry the focussing tube with the eye-piece. The Editor has in hand a short article on the construction of eye-pieces, giving the fundamental principles, which will enable anyone to construct one of any power. No doubt it will appear as soon as possible, when GANELON will find all the information he needs.—O. B.

Xylonite.—R. W. (*Blaina*).—The address of the Company is—The British Xylonite Company, Limited, 124, High Street, Homerton, E.

Picture-Frame Clay.—J. T. H. (*Bacup*).—The clay mentioned in Picture-Frame Gilding, Vol. III., No. 121, page 262, is prepared clay ground fine by machinery, and sold at any reliable artists' colourman's as "gilders' clay." There is no difficulty in getting this, as any of G. Rowney's agents will sell it at 9d. per lb.—H. E. M.

Sensitised Paper.—J. D. (*Hull*).—Albumenised paper is sensitised by floating it for three or four minutes on a solution of silver nitrate of about fifty grains to the ounce of distilled water, then drying in the dark, in a warm current of air free from gas or other noxious vapour or dust. When dry, the paper should be either rolled tightly or laid flat under pressure until required for use. The custom is in sensitising, after the paper has laid a sufficient time on the silver solution, to carefully raise it by two corners and draw it over a glass rod fastened to the end of the dish in order to remove the surface moisture as much as possible; the remaining moisture is blotted off with pure blotting paper. The sensitised paper is then hung up to dry. As to the preparation on dry plates that J. D. alludes to, it is an emulsion of bromide and iodide of silver in a strong solution of gelatine, for which there are many formulæ. The best plan would be to procure a hand-book on the subject. Abney's "On the Preparation of Gelatine Emulsions" is about the best; and make yourself thoroughly acquainted with the process.—D.

Patentees.—R. E. (*Bolton*).—Indexes to WORK, Vols. I. and II., can be procured of any bookseller, or of Cassell & Co., London, E.C. Price one penny—with postage, three-halfpence.

Copying a Medal.—H. H. (*No Address*).—We much doubt whether H. H. will succeed in making a satisfactory copy of the medal in question by *casting* in metal; he will find electrotyping a far superior method. Let him oil one side of the medal, but very slightly, so as not to fill up any of the depressions, tie a slip of stiff paper round the edge to form a rim, and having mixed *fine* plaster as thick as cream, pour it on to form the mould. The second side will be treated in the same manner. These moulds, when dry, should be rendered non-porous by laying them face downwards in melted wax. Their faces then need to be brushed over with black-lead, and they are ready for the bath of dissolved copper. If the copyist has no electrotyping apparatus, his better plan will be to hand his moulds to a professed electrotyper, and let him place them in his bath. This he will do for the merest trifle, as they will give him no trouble beyond simply hanging them in the solution of copper. But for small matters, such as medals, and for the use of copper only, all the needful apparatus may be set up for a few pence. The electrotyping process reproduces the minutest touches on the object copied with absolute fidelity. The shells of copper which will be deposited when removed from the moulds may be backed up with soft metal—lead with a little tin and antimony in it—either together or separately; and the faces can be bronzed in various ways, or, if desired, coated in the bath with a film of gold or silver.—S. W.

Small Organ.—G. W. O. (*Durham*).—The dimensions of the parts for the organ referred to in the answer to GOOD TIPS (see page 108, column 3, No. 111) are as follow:—Sound-boards, 3 ft. 9 in. long. Total width when joined together, about 16 in. Wind chest, same size, and 4 in. deep. Bellows, 3 ft. 4 in. long, 14 in. wide; middle board of bellows 3 in. longer, so as to rest on supports on building frame. Building frame, 3 ft. 9 in. long; same width as the two sound-boards, and about 3 ft. 6 in. higher, or a few inches higher if couples or pedals are required. As regards general construction, I should advise you to obtain one of the books on organ building which have frequently been mentioned in these columns.—M. W.

Organ Building.—C. W. T. (*Old Trafford*).—It would require too much space to give you all the information you require as to scales, thickness of wood, lengths, voicing, etc. Your best plan would be to purchase one of the books mentioned frequently in these columns, which would give you all the information you require on these points, and on other matters connected with organ building. Any reply which I could give in these columns would be too meagre to be of much service to you.—M. W.

Wind Trunk for Organ.—J. E. B. (*Smallheath*).—The wind trunk for your organ should not be less than 10 in. wide by 2 in. deep; if you have space to spare so as to make it 2 in. or 3 in. wider, so much the better. The pedal wind trunk may be about 10 in. wide and 2 in. deep if single; but if two are used, make them each 5 in. by 2 in. The length of these trunks depends entirely on the height of your building frame; they must be long enough to reach from the trunk band to the wind chest in each case. The manual wind trunk will be about 3 ft. 6 in. long, and pedal one about 16 in., but it is impossible to give the exact lengths. You can easily find them for yourself when you have constructed your building frame, etc.—M. W.

Organ Pipes.—F. B. (*Oldham*).—You are quite right; there is a slip in the reply to F. W. (*Sheffield*), at the top of page 220 (No. 118). It should read that the 16 ft. tone can be obtained from a stopped pipe 8 *feet* long, not 4 *feet*.—M. W.

Watch Cylinder.—SILVER WATCH.—When a horizontal escapement is at rest, the scape tooth may not always be in the same position, it may be inside or outside, or partly both; but in case, the distance the balance moves from the point of rest should be equal both ways. If it is not so, shift the collet (hairspring-collet) round until it is equal. Generally there is a dot mark on edge of balance and three on the plate; when at rest, the one on balance agrees with the centre one on the plate; the others coincide with the one on the balance when scape wheel drops off. The lever escapement is also the same, the balance moving equal distances from the point of rest, or may be made so by moving hairspring or roller.—A. B. C.

Gilding on Glass.—T. W. V. (*Leicester*).—Any communication you may make in the pages of "Shop" upon this subject shall have consideration; or you may send in an article, on approval, on the terms of payment usual with the journal.

Brass Savings Bank.—D. S. (*Glasgow*).—You must please state more definitely what kind of savings bank you require a design of, or if the pattern is left for the choice of the replier to your question. You seem to write as if you require a sketch of an existing article.—J. S.

Electric Current from a Battery.—P. R. (*Birmingham*).—The total volume of electric current obtainable from a battery is equal to its total electro-motive force divided by its total resistance. The total volume of current obtainable from it through work being done by the current will be equal to its total electro-motive force divided by *all the resistances* in the circuit. Hence, although the current volume of one cell may be the same as that obtainable from ten cells connected in series when taken by themselves, a far different result is shown when the resistance of instruments and of work placed in the circuit is added to the internal resistance of the battery cells. Suppose, for instance, we connect one cell to an ammeter having a resistance of ·005 ohm, we shall have to add this to the resistance of the cell, and the result will then be $\frac{1{\cdot}86}{{\cdot}08 + {\cdot}005} = 21{\cdot}88$ ampères, instead of 23·25 ampères. If, now, we connect ten cells in series with the ammeter, the reading should be $\frac{1{\cdot}86 \times 10 = 18{\cdot}60}{{\cdot}08 \times 10 + {\cdot}005 = {\cdot}805} = 23{\cdot}10$ ampères, because the ·005 resistance of the ammeter is divided among ten cells. Now, if you connect some accumulators in circuit with the ammeter and your 10-cell Bunsen battery, you must add the resistance of the accumulator cells to that of the Bunsen cells and ammeter, and also the resistance of the connecting wires. Now, supposing the resistance of the accumulator cells to be 8 ohms, that of the connecting wires, screws, and ammeter to be ·2 ohm, and the internal resistance of the battery cells to be ·8 ohm, then the current will be $\frac{1{\cdot}86 \times 10 = 18{\cdot}60}{{\cdot}08 \times 10 + {\cdot}2 + 8 = 9} = 2{\cdot}06$ ampères, and this agrees with the reading of your ammeter when charging is commenced. As the internal resistance of the accumulators increases whilst being charged, owing to the back electro-motive force of the charged plates, the current volume is lowered, hence, your ammeter then gives a reading of 1·5 ampères. I hope you will now clearly understand why the volume of current from your battery is reduced whilst connected to work being done by the current.—G. E. B.

Rat Cage.—J. H. (*Cork*).—Figs. 1 and 2 show a small cage open and closed for white rats or mice. It is really a wire cage made to slide in and out of a wooden box. To make such a cage, cut two strips of mahogany 3 ft. long by ⅝ in. Cover one angle with tin; temporarily fasten the tin on; mark off half inches on the two sides covered with tin; then bore the holes for the wires with a strong bradawl through the tin into the wood. This will fasten the

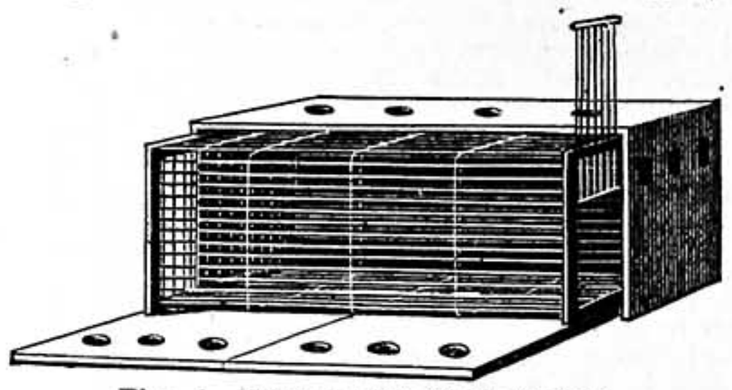


Fig. 1.—White Rat Cage (open).

tin on. Cut each strip into four, join them into two strong frames, and wire them as illustrated, leaving eight wires for the sliding door. Have four stout wires 18 in. long, and fix them into the corners of the frame. Make a box of ½ in. deal an inch deeper than the wire cage, as per figures. The inch allowance will form a tray for the sawdust at the bottom of the cage. To clean the cage out, open the two doors in front, withdraw the wire cage, and knock

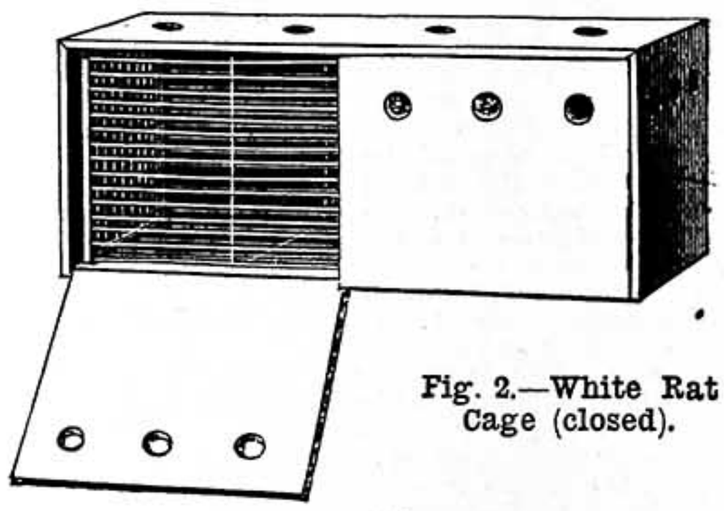
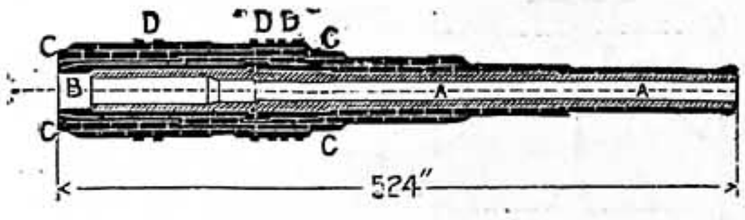


Fig. 2.—White Rat Cage (closed).

out the box. Sprinkle some fresh sawdust in the bottom, and replace the wire cage. To form a nest for the rats, a piece of wood is fastened inside the wires at one end; or, what is better, a little box can be made to fit the inside of the cage. This form of cage on a larger scale answers equally well for squirrels, and smaller, for white mice.—F. H.

110-Ton Gun.—LITTLE JIM.—The figure shows the 110-ton gun in section. It is constructed entirely of steel. Like all heavy guns made in this country, there are two essential portions, the inner tube and the outer section. In the figure, the inner tube is indicated with fine shading, and the outer portion with more open shading. The inner tube, A, is made of a single piece of Whitworth compressed steel. Over this is shrunk the breech-piece, B, and around this again are shrunk three layers of steel hoops, C. It will be noticed that all of the main hoops, as well as the breech-piece and the inner tube, are provided with shallow shoulders. The shrinkage of the hoops causes longitudinal



110-Ton Gun.

pulls against these shoulders, and their arrangement is such that there is a system of perfect and mutual resistance to longitudinal stress in each section of the gun. There are no trunnions. At D D a series of rings are formed on the outermost or "trunnion hoop." Three strong bands pass round between these rings and tie the gun to its carriage. The dimensions of the gun are as follows:—Total length, 524 in.; length of bore, 487 in.; length of ripling, 393 in.; diameter of bore, 16·25 in.; diameter of powder chamber, 21·125 in.; cubical capacity of chamber, 28,610 cubic in.; weight of gun, 247,795 lbs.; weight of powder charge, 960 lbs.; weight of shot, 1,800 lbs.; muzzle velocity, 2,128 ft. per second; total energy, 56,520 foot-tons.—J.

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—H. P. (*Leeds*); G. F. J. (*London, W.*); A. H. J. (*Norwich*); A. C. (*Leicester*); E. W. (*Halifax*); A. J. (*London, N.*); P. T. (*Birmingham*); W. P. (*Southport*); WATER; SOUTHPORT; H. F. (*Gateshead-on-Tyne*); J. M. (*Sutton-on-Hull*); J. H. (*Ballina*); C. (*Lewisham*); G. T. (*Sunderland*); NORTH JACK; POTASH; GALVANOMETER; A NOVICE; S. AFRICA; H. D. (*West Norland*); D. S. R. (*Glasgow*); AIRDIE; A. S. (*Addiscombe*); W. R., JR. (*Carlisle*); IRISH DISTRESSED LADIES' FUND; F. B. (*Aldershot*); J. R. (*Liverpool*); J. M. F. (*Notting Hill*); HODGE; E. S. (*Birmingham*); S. P. A. (*Walthamstow*); M. & C. (*Grimsby*).

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